THE

Malayan Agricultural Journal.

JULY, 1936.

EDITORIAL.

Padi.

The importance of increasing yields of padi per acre has been rightly stressed on frequent occasions. In an article in a previous issue the results of experiments designed to determine the type or types of soil on which high yields of padi might be expected were described. To this end soils representative, as far as possible, of well-known padi areas were selected, and attempts were made to grow padi on all of them under exactly comparable conditions. The soils used in these experiments were of ten different types and were placed in unglazed earthenware containers. In the present number we publish an account of further experiments on growing padi in pots, by Mr. J. H. Dennett, Soils Chemist. The object of these experiments is principally to determine what treatment will raise yields above the so-called "bar", and subsequently to endeavour to ascertain, assuming that a suitable treatment is discovered, whether it is sound economically, and also to indicate the lines which future trials should take and where the more positive results are likely to be obtained. In certain countries, namely America, Japan and Italy, average yields of padi are recorded which are considerably higher than those usually obtained in Malaya, and it has been considered that the effect of daylight on growth is in some way responsible for this. In the countries mentioned the hours of daylight in the summer, as is well-known, are longer than those enjoyed in Malaya; thus, attempts, which are also described in Mr. Dennett's article, have been made to determine the effect of extra daylight on the growth of padi by illuminating the plants under experiment nightly from 10 p.m. to sunrise, until flowering commenced.

Copra.

In the April number of this Journal we published the first of a series of articles by Mr. F. C. Cooke, the Officer-in-Charge of Copra Investigations, on the construction of copra kilns suitable for owners of small areas of coconuts. The first article on experiments designed to assist small-holders to turn out good quality copra was published in the *Malayan Agricultural Journal* in the issue of July 1932. In the interim there has been a considerable fall in copra prices and, although there has been a definite recovery during the last twelve months, it is still desirable that unscorched dry white copra which will command the best market should be produced. This

can be achieved if kilns of certain design are employed. It has been found, however, that, owing to the fact that the majority of small-holders operate their kilns only once or twice a month, neither of the two kilns known as the "10" and "30 acre" kilns described in Part I of the present series of articles has aroused any considerable degree of interest, the "30 acre" kiln being considered only large enough for properties of less than 3 acres, and the "10 acre" too small.

A further article on kiln construction is published in this number, and the author points out that the system of naming kilns on a basis of maximum mature acreage and regular operation is unsatisfactory, and for these reasons has drawn up a code in which kiln sizes are based on acreage which is not directly specified but is indicated by a type number. This number indicates the area which the kiln could serve if used intermittently; ten times the type number shows the acreage for which the kiln is suitable if used continuously, and, multiplied by 100, it gives the approximate nut capacity of the kiln. Consequently the designation "10 acre kiln" is replaced by kiln Type 1 and "30 acre kiln" by kiln Type 3. Other types of kiln have also been allotted type numbers and three of these, namely 7, 8 and 15, are described in the article in detail, with particulars of the cost of their construction. The account of kiln Type 8 is contributed by Mr. C. W. S. Hartley, Agricultural Officer, Perak South.

Important constituents in the construction of a copra kiln are bricks, and it would seem to be greatly to the interest of the small-holder if he were able to make these himself from such material as is likely to be found on the spot or in the near neighbourhood. A note is therefore added as an appendix to Mr. Cooke's article, giving a brief account of the elements of brickmaking.

Original Articles.

FURTHER POT EXPERIMENTS WITH PADI

BY

J. H. DENNETT,

Soils Chemist.

For several years field work has been carried out by the Department of Agriculture with the object of increasing the yield of padi per unit area.

New strains of higher-yielding varieties have been isolated and bred and at the same time standard manurial trials have been laid down. In manurial trials it was always found possible to obtain increases of yield of some 30 per cent. on the medium, and even greater on the poorer soils, but with a crop of low value like padi only on the poorer soils is manuring found to be an economic proposition, and generally only where there are cheap local supplies of fertilizer. Further, it was found that sooner or later a "bar" was encountered above which normal manuring would not raise the yields.

In the prelude to his summary of padi manurial experiments for 1933-34 the Chief Research Officer made the following remarks:—

"The deductions drawn from previous experimental work were:—

(*a*) that whatever fertilizers gave results, phosphorus was found to be the essential element.

(*b*) that there appeared to be a bar above which yields could not be raised by any system of manuring with close planting. The bar apparently varied from 400 to 500 gantangs per acre depending on soil type and water conditions, and where, as is generally the case on the Stations, the normal yield approaches the hypothetical bar, manuring with fertilizers only gave uneconomic increases".*

In recent years more complex experiments have been tried with planting distances, varying cultural treatments such as green matter turned in early or late, or "chelluping"† either alone or combined with standard manurial experiments. The results were the same and no normal course appears to surmount the "bar". At the same time certain areas naturally gave yields above the bar and this led to the trials in pots with heavy uneconomic dressings of fertilizers.

In the *Malayan Agricultural Journal* for December, 1933 the results of trials of padi in irrigated pots on different types of soil were reported.

In those experiments the following soils were used:—

(1) Titi Serong (Perak).

(2) Selinsing (Perak).

(3) Pulau Gadong (Malacca).

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* *Malayan Agricultural Journal*, Vol. XXII, December, 1934, page 583.

† Chelluping = dipping of the seedling into a thin manure paste before planting out in the field.

Table

Padi Pot Expe-

Soils	Dressed at rate of 4 tons green manure per acre						
	Raub Normal	Kuala Lumpur		Kuala Pilah	Kamunting		Lenggong
Line	Row 1	Row 1	Row 2	Row 1	Row 1	Row 2	Row 1
1—4	10 cwt. P_2O_5 30 cwt. K_2O	Nil	As row 1 & 10 cwt. SiO_2	10 cwt. P_2O_5	10 cwt. P_2O_5	10 cwt. P_2O_5 10 cwt. CaMg	10 cwt. P_2O_5
5—8	10 cwt. P_2O_5 7 cwt. K_2O	10 cwt. P_2O_5	As row 1 & 10 cwt. SiO_2	10 cwt. P_2O_5 10 cwt. CaMg	20 cwt. P_2O_5	40 cwt. P_2O_5 10 cwt. CaMg	20 cwt. P_2O_5
9—12	40 cwt. P_2O_5 7 cwt. K_2O	20 cwt. P_2O_5	As row 1 & 20 cwt. SiO_2	30 cwt. P_2O_5	40 cwt. P_2O_5	40 cwt. P_2O_5 40 cwt. CaMg	40 cwt. P_2O_5
13—16	40 cwt. P_2O_5 30 cwt. K_2O	40 cwt. P_2O_5	40 cwt. P_2O_5 40 cwt. SiO_2	30 cwt. P_2O_5 30 cwt. CaMg	60 cwt. P_2O_5	40 cwt. P_2O_5 40 cwt. CaMg	60 cwt. P_2O_5

Pots 4, 8, 12 and 16 in the case of Kuala Lumpur, Kamunting and Kuala Pilah treated in each case with peat as shewn in text.

10 cwt. of N. means 10 cwt. of ammonium sulphate or its equivalent, N. being used for brevity.

I.

riments 1935.

No green manure.						
Titi Serong	Malacca	Selinsing	Raub High-yielding	Penang		
Row 1	Row 1	Row 1	Row 1	Row 1	Row 2	
2 cwt. insoluble nitrogen (form. urea).	2 cwt. insoluble nitrogen (form. urea). 30 cwt. P_2O_5	2 cwt. insoluble nitrogen (humic acid)	10 cwt. insoluble nitrogen (form. urea). 10 cwt. P_2O_5	10 cwt. insoluble nitrogen (horn)	As row 1 + 10 cwt. Silica.	Second row of Kuala Pilah, Titi Serong, Malacca, Selinsing, Raub High-yielding and Lenggong as first row, but artificially lighted from 10 p.m. until sunrise.
30 cwt. - do. -	30 cwt. - do. -	20 cwt. - do. -	40 cwt. - do. - 10 cwt. P_2O_5	40 cwt. - do. -		
2 cwt. soluble nitrogen (Am_2SO_4)	2 cwt. soluble nitrogen (Am_2SO_4) 30 cwt. P_2O_5	30 cwt. Am_2SO_4 30 cwt. P_2O_5 22 cwt. K_2O	10 cwt. - do. - 40 cwt. P_2O_5	10 cwt. - do. - 10 cwt. CaMg		
20 cwt. - do. -	30 cwt. - do. - 30 cwt. P_2O_5	30 cwt. Am_2SO_4 30 cwt. P_2O_5 22 cwt. K_2O 30 cwt. CaMg	40 cwt. - do. - 40 cwt. P_2O_5	10 cwt. - do. - 40 cwt. CaMg		

10 cwt. P_2O_5 means 10 cwt. superphosphate.
10 cwt. K_2O means 10 cwt. potassium sulphate.
10 cwt. CaMg means 10 cwt. of a mixture of calcium carbonate, calcium sulphate, magnesium carbonate, and magnesium sulphate in molecular proportions.

(4) Kamunting (Perak) (reslimed mining land).
(5) Kuala Lumpur (ordinary typical Hill Quartzite soil).
(6) Lenggong (Perak) high-yielding area.
(7) Kuala Pilah (typical granite padi soil).

At the end of the 1933 season the cages and pots were further extended to make up 32 pots instead of 30 for each soil type, and the following additions were made:—

(8) Raub (Pahang) high-yielding area.
(9) Raub (Pahang) normal-yielding area.
(10) Penang Island (Balik Pulau) the highest-yielding padi soil in Malaya and showing itself richest by chemical analysis.

1934 Season.

From the results obtained in the 1933 season already reported on, it appeared possible that the following might be important, (1) silica, (2) calcium and magnesium, (3) heavy dressings of phosphate and/or nitrogen.

The proposals were based on the fact that in the previous season (1) there was an increase in silica content of the ash with yield, (2) there appeared to be a relationship between the combined calcium and magnesium and yield, (3) the high-yielding soils were definitely richer in nitrogen and phosphates.

Small quantities of minor elements were added to certain soils.

In order that results should be available by the end of the year planting was carried out in March. Unfortunately the padi was considerably attacked by stem borers, and, from information supplied by the Government Entomologist, it would appear that this may be expected if planting is made earlier than the end of May (in Selangor).

The attack vitiated most of the results and the only definite conclusion was that the padi receiving dressings up to 10 cwt. of ammonium sulphate and/or superphosphate shewed remarkably early growth. In nine out of thirteen cases silica added in the form of 10 cwt. of sodium silicate shewed increases of growth over similar treatments without silica.

Mixtures of calcium and magnesium in the form of carbonates and sulphates also shewed increases.

1935 Season.

On the advice of the Government Entomologist, in order to avoid, if possible, the incidence of borer attack, the nursery in 1935 was prepared considerably later and the padi was not planted out until the last week in May. Less than one half per cent. of the plants were attacked in consequence.

Treatments.

From laboratory observations made on a number of padi soils over a period of some two years it was found that there were considerable losses of nitrogen in the form of ammonium sulphate in the irrigation water and to a smaller degree

of phosphate. It is possible that no such loss occurs under growing padi, but these losses suggested a relationship with availability.

In 1934 the writer discussed the question of ammonium losses with the scientific staff of the Imperial Chemical Industries Research Station at Jealott's Hill. The problem was (*a*) whether lack of response to nitrogen above a certain point was due to most of the nitrogen disappearing in the drainage water as ammonium sulphate or (*b*) could yield be increased by the addition of ammonium sulphate or nitrogen in any form to bring the nitrogen content of an average soil up to that of the higher-yielding soils like those of Penang and Lenggong.* To overcome the loss of ammonium sulphate it was decided to add nitrogen in insoluble forms and for this purpose the writer is indebted to Mr. H. J. Page, Head of the Research Station at Jealott's Hill, for samples of the following:—

		per cent.
Urea formaldehyde powder	N_2	23.1
Ground horn		18.1
Humic acid		4.5
Nitrated coal		9.2

At the same time it was decided that dressings of phosphate, potash and calcium or magnesium, sufficiently heavy to be commensurate with the total content of an average soil, should be tried out. This involved dressings up to 60 cwt. of superphosphate, 40 cwt. of combined calcium and magnesium salts, 22 cwt. of potash and 30 cwt. of ammonium sulphate or its equivalent nitrogen in an insoluble form.

It was hardly to be expected that any of these dressings were likely to be economic but high hopes were entertained that this would prove to be the solution of the "bar" to higher yield encountered at about 500 to 600 gantangs. The extent to which these hopes were justified will be shown below.

In view of the differences in yield obtainable in Malaya and in America, Japan or Italy it was decided also to determine the effect of extra daylight on growth of padi in Malaya.† For this purpose an additional sixteen pots of each of the following soils were shielded from the rest by a wall. Twelve shaded lights, six with ordinary 75 watt bulbs and six with 75 watt daylight blue bulbs, were placed at a height of 5 feet 6 inches over the following pots of soils:

(1) Kuala Pilah
(2) Titi Serong
(3) Malacca
(4) Selinsing
(5) Raub
(6) Lenggong.

These lights were on from 10 p.m. until sunrise.

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* In this connexion it should be remembered that in Java with padi growing on terraces it is possible to remove the water and add manure periodically during the growing season.

† This has been investigated in Japan by Yutaka Fuke, *vide* Journal of Imperial Expt. Station (Tokyo), Vol. I, No. 4, March, 1931.

Peat.

In order to get more exact observations on the effect of peat, than were available, raw peat from Kuala Selangor District, having a nitrogen content of 1.02 per cent. (on dry) and dry matter content of 12 per cent. and pH 4.5 to 5.0, was added to every fourth pot of the following soils:

Both rows of	Lenggong	Pot 4 500 gms.
	Kuala Pilah	Pot 8 1,000 ,,
	Kuala Lumpur	Pot 12 1,500 ,,
	Kamunting	Pot 16 2,000 ,,

The exact detailed and rather complicated lay-out is given in the table attached.

Discussion of Treatments.

Raub Poor.

1st row only. Testing the effect of high and medium dressings of phosphate against high and medium potash. Nitrogen supplied the same throughout as green manure and neglected as manurial factor (poor to medium soils).

Kuala Lumpur.

1st row. Testing effect of medium to heavy phosphate dressings without potash, with nitrogen supplied as green manure throughout and neglected. Peat in every fourth pot (very poor non-padi soil).

2nd row. Testing effect of addition of varying quantities of sodium silicate to the phosphate treatments of 1st row. Nitrogen as above. Peat in every fourth pot.

Kuala Pilah.

1st row. Testing effect of medium and heavy dressings of phosphate with calcium and magnesium salts. Nitrogen treatment as above (poor soil). Peat in every fourth pot.

2nd row. As first row with artificial lighting.

Kamunting.

1st row. Testing the effect of 10 to 60 cwt. of phosphate on a rather better soil than Kuala Lumpur. Nitrogen as above. Peat in every fourth pot.

2nd row. As Kuala Pilah 1st row above.

Lenggong.

1st row. Testing the effect of 10 to 60 cwt. of superphosphate on a high-yielding soil. Peat in every fourth pot. Nitrogen as above.

2nd row. As first row with artificial lighting.

Titi Serong.

1st row. Confirming effect of normal (2 cwt.) and heavy (30 cwt.) dressings of ammonium sulphate against similar dressings of insoluble nitrogen in the form of form: urea (good soil).

2nd row. As first row with artificial lighting.

Malacca.

1st row. As for Titi Serong but with the addition of 30 cwt. of superphosphate throughout (fairish soil).

2nd row. As first row with artificial lighting.

Selinsing.

1st row. First four pots have light dressing of insoluble nitrogen, and next four heavy dressing to compare with Titi Serong above, the form: urea being replaced by humic acid. Third four pots have a complete heavy dressing of N.P.K., and last four have similar dressing with the addition of calcium and magnesium (good soil).

2nd row. As first row with artificial lighting.

Raub Good.

1st row. Testing combinations of medium and heavy dressings of insoluble nitrogen (form: urea) and medium and heavy dressings of superphosphate (high-yielding soil).

2nd row. As first row with artificial lighting.

Penang.

1st row. Comparison of medium and heavy dressings of insoluble nitrogen in the form of horn and testing of medium dressings (10 cwt.) (of horn) against medium and heavy dressings of calcium and magnesium.

2nd row. As first row with the addition of 10 cwt. of sodium silicate.

Growth.

As in the previous two seasons, practically no supplying was necessary and the plants made rapid progress from the start. Those which were to be submitted to artificial light were allowed three weeks to become established, before treatment.

Within two or three weeks it became apparent that with some treatments padi was making phenomenal growth. This applied particularly to Raub (high-yielding) Penang (high-yielding), Raub (normal-yielding) and Kuala Pilah (poor-yielding).

In the earliest stages Raub (normal) treated with phosphate and potash only, had the best appearance but by the end of two months the lack of nitrogen was showing in the yellowish colour of the leaves. Normal dressings of both nitrogen and phosphate have frequently resulted in abnormally good growth which is not

apparent later but this phenomenal growth seems to have been maintained generally in these experiments.

Malacca soil treated with high and low soluble and insoluble nitrogen gave interesting growth results. Those treated with 2 cwt. ammonium sulphate shewed excellent early growth, while those treated with 30 cwt. seemed to be suffering from acute poisoning from which the plants nearly died. Those treated with insoluble nitrogen shewed excellent early growth with little difference between the heavy and light dressings. Plants treated with the heavy dressings of ammonium sulphate managed to recover, however, and finally shewed abnormally good growth compared with the normal ammonium sulphate dressing.

Similar results were obtained with the Selinsing soil which was given a heavy dressing of ammonium sulphate.

In the series with artificial daylight, a different effect was observed for both these soils. In this case the heavy dressing of ammonium sulphate gave excellent growth from the beginning.

In general, at the end of two months, all nitrogen-dressed soils had a deeper green padi than those not so treated, with the exception of those treated with peat, where the padi generally appeared to be suffering from chlorosis.

Artificial Light.

For the first two or three weeks after artificial light treatment was commenced there was little to choose between pots undergoing such treatment and those with normal daylight. Later, plants with normal light were taller while the artificially lighted ones were sturdier. As the season progressed this became more marked until there was at least a foot difference in the average height while the number of tillers produced was much the same.

At the end of four months the normally lighted pots were in flower and had become so unusually tall that it was necessary to raise the roof of the cage by some two feet, their height being over 7 feet. At the end of this period there was no sign of flowering in the artificially lighted cage and the height was about 5 feet, but the number of tillers shewed an increase over the normally lighted. At the end of five months the height of the artificially lighted padi was sufficient to reach the source of illumination in places, thus causing one corner to be darkened. Padi in this corner rapidly came into flower. At the beginning of November this artificial lighting was stopped and all padi started to flower.

The Yields.

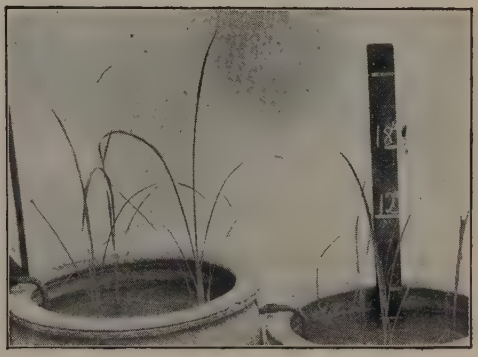
In the 1933 experiments it was found that yields could be converted into gantangs per acre by multiplying the yield (in pounds) of four pots (one treatment) by the inverse of the area in acres of these four pots. This gave the yield per acre in pounds. Division by 5.5 gave gantangs per acre.* The figures so obtained approximated closely to those taken in the field for similar soils. Yields taken in

* Measurements over all the pots shewed that the average figure (from which variation was small) for density of grain was about 5.5.

1935
At two months
MALACCA
30 cwt. Form: Urea

1935
At two months
MALACCA
30 cwt. Am. Sulphate

1935
At two months
MALACCA
Artificial lighting
30 cwt. Am. Sulphate



1933
At two months
MALACCA
No treatment

1935
At two months
LENGGONG
4 tons Green Manure, 10 cwt. P_2O_5

1935
At two months
LENGGONG
4 tons Green Manure, 60 cwt. P_2O_5

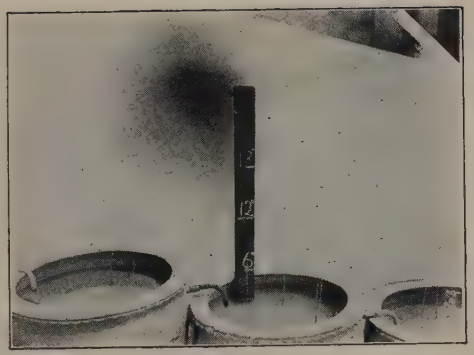
1934
At two months
LENGGONG
1½ cwt. P_2O_5, 20 lbs. Copper Sulphate, 1 cwt. Am. Sulphate, 20 lbs. Manganese Sulphate.

1933
At two months
LENGGONG
No treatment.

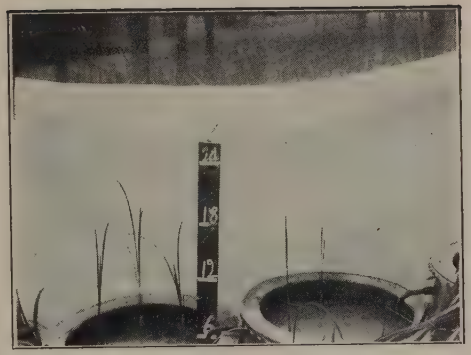
1935.
At two months
SELINSING
Artificially lighted
2 cwt. Humic Acid.

1935
At two months
SELINSING
30 cwt. P_2O_5, 30 cwt. Am. Sulp.
22 cwt. Potash : 30 cwt. Ca.Mg.

1933
At two months.
SELINSING
No treatment.



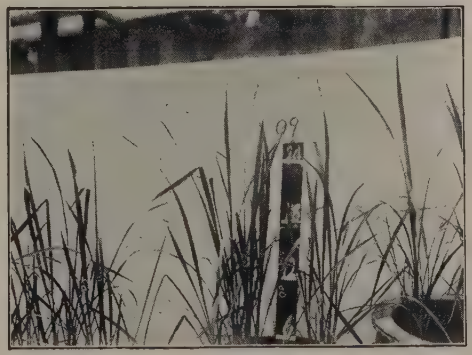
1933
At two months
KUALA LUMPUR
No treatment.



1934
At two months
KUALA LUMPUR
4 tons Green Manure.

1935
At two months
KUALA LUMPUR
4 tons Green Manure.

1935
At two months
KUALA LUMPUR
4 tons Green Manure, 40 cwt. P_2O_5



1934
At two months
KUALA LUMPUR
3 cwt. P_2O_5, 2 cwt. Am. Sulphate.

1934
At two months
KUALA LUMPUR
3 cwt. P_2O_5, 2 cwt. Am. Sulphate, 10 cwt. Ca.Mg.

Table II Yields

Factor	All Treated with 4 tons Green Manure per acre.													
	Raub (Normal)					Kamunting								
	10 cwt. Super 30 cwt. Potash	10 cwt. Super 7 cwt. Potash	40 cwt. Super 7 cwt. Potash	40 cwt. Super 30 cwt. Potash	1933	10 cwt. Super	20 cwt. Super	40 cwt. Super	60 cwt. Super	10 cwt. Super 10 cwt. CaMg	40 cwt. Super 10 cwt. CaMg	10 cwt. Super 40 cwt. CaMg	40 cwt. Super 40 cwt. CaMg	1933
Mean tillers at 2 months	10.0	10.4	10.4	10.8	—	8.5	8.0	9.3	9.9	10.1	8.4	6.5	8.3	5.77
Mean tillers at harvest	13.07	8.34	8.16	7.17	—	8.44	7.34	6.47	6.69	9.33	8.9	9.45	9.69	3.7
Mean height at 2 months	51″	54″	50″	48″	—	44″	43″	41″	40″	48″	44″	44″	42″	33″
Mean height at harvest	61″	66″	54″	55″	—	55″	61″	48″	52″	62″	55″	56″	51″	38″
Mean spikelets per tiller	4.1	10.5	9.1	12.4	—	8.7	9.0	10.8	9.8	8.2	6.5	5.0	6.6	2.69
Mean weight in grams of grain per plant (a)	13.5	25.1	25.4	26.4	—	27.2	22.7	19.1	17.8	30.0	17.2	17.4	12.2	
(b) peat	—	—	—	—	—	5.3	4.7	7.0	6.5	5.3	8.3	5.5	11.7	
Mean calculated yield in gantangs per acre (a)	**560**	**1055**	**1050**	**1090**	Figure for 1933 pots not available—field estimate 350.	**1130**	**940**	**745**	**740**	**1250**	**710**	**725**	**510**	**365**
(b) peat	—	—	—	—		**718**	**417**	**553**	**832**	**220**	**345**	**232**	**485**	
Ratio mean grain/straw	0.34	0.72	0.83	0.88		0.90	0.82	0.73	0.80	0.80	0.99	0.92	0.70	
Ratio mean grain/stalk	0.87	1.35	1.60	1.92		1.86	1.83	1.40	1.63	1.85	2.39	2.04	1.93	
Percentage increase cf. 1933	60	201	200	211		213	158	105	104	243	96	98	40	
Significant difference between treatments (gantangs) (a)		450					270				376			
(b) peat														
Remarks on (a) Growth	Poor	Poor	Poor	Poor		Poor	Medium	Poor	Poor	Medium	Medium	Medium	Medium	
(b) Stalks	Thin	Thin	Thick	Thick		Large and thin	Large and thin	Large and thin	Large and thin	Thin	Thin	Thick	Thin	
Percentage of empty glumes (a)	12.7	8.11	4.57	1.44		7.47	2.78	6.33	4.92	2.9	2.76	3.48	3.75	
(b) peat	—	—	—	—		9.65	2.77	3.98	0.85	1.36	3.66	5.37	5.42	

Note:—There was no manurial treatment in 1933.

Table II (*Continued*)

Factor	All Treated with 4 tons Green Manure per acre.									
	Lenggong					Kuala Pilah				
	10 cwt. Super	20 cwt. Super	40 cwt. Super	60 cwt. Super	1933	10 cwt. Super	10 cwt. Super 10 cwt. CaMg	30 cwt. Super	30 cwt. Super 30 cwt. CaMg	1933
Mean tillers at 2 months	8.9	8.4	9.0	8.4	5.57	11.3	11.4	9.7	11.0	1.12
Mean tillers at harvest	10.8	8.66	9.9	7.1	4.84	12.6	12.1	10.05	11.6	—
Mean height at 2 months	52″	53″	46″	46″	39″	49″	46″	50″	44″	37″
Mean height at harvest	72″	70″	64″	66″	52″	61″	64″	58″	68″	—
Mean spikelets per tiller	8.2	8.0	7.8	8.3	4.89	8.4	9.2	7.7	6.5	5.23
Mean weight in grams of grain per plant (a)	56.7	44.7	28.9	47.2		49.1	36.7	15.5	31.7	
(b) peat	35.0	30.0	35.0	24.0		17.3	10.0	13.3	20.0	
Mean calculated yield in gantangs per acre (a)	**2330**	**1860**	**1725**	**1840**	**960**	**2020**	**1510**	**645**	**1320**	**220**
(b) peat	**1650**	**1250**	**1450**	**986**		**720**	**555**	**555**	**830**	
Ratio mean grain/straw	1.01	1.01	0.66	1.27		0.63	0.54	0.30	0.44	
Ratio mean grain/stalk	1.58	2.84	1.00	3.37		1.71	2.16	2.01	2.21	
Percentage increase cf. 1933	143	94	80	92		818	586	193	500	
Significant difference between treatments (gantangs) (a)		650					390			
(b) peat		540					337			
Remarks on (a) Growth	Good	Medium	Medium	Good		Medium	Medium	Medium	Medium	
(b) Stalks	Thick	Thin	Thick	Thick		Thin	Thin	Thin	Thin	
Percentage of empty glumes (a)	2.32	0.76	4.95	0.58		6.18	1.98	4.28	1.62	
(b) peat	7.74	6.08	8.75	8.52		9.8	2.86	5.5	1.7	

Note :—There was no manurial treatment in 1933.

Table II (*Continued*)

Factor	Treated with 4 tons Green Manure per acre. Kuala Lumpur (Hill Quartzite)									No Green Manure Raub (High-yielding)				
	Nil	10 cwt. Super	20 cwt. Super	40 cwt. Super	10 cwt. Silica	10 cwt. Super 10 cwt. Silica	20 cwt. Super 10 cwt. Silica	40 cwt. Super 10 cwt. Silica	1933	10 cwt. Super 10 cwt. Form: Urea	10 cwt. Super 40 cwt. Form: Urea	40 cwt. Super 10 cwt. Form: Urea	40 cwt. Super 40 cwt. Form: Urea	1933
Mean tillers at 2 months	2.1	8.0	8.6	7.0	2.4	8.5	7.89	8.46	—	10.7	11.8	10.2	12.2	
Mean tillers at harvest	2.78	6.33	5.79	6.12	3.45	7.33	7.33	5.78	—	8.76	10.72	8.75	11.1	
Mean height at 2 months	38″	43″	39″	38″	40″	45″	44″	38″	5″	55″	59″	52″	52″	
Mean height at harvest	49″	51″	47″	48″	81″	53″	52″	49″	died	74″	87″	75″	72″	
Mean spikelets per tiller	—	5.0	5.3	2.1	—	7.6	6.5	6.4	—	10.2	10.1	10.1	10.2	
Mean weight in grams of grain per plant (a)	—	6.2	8.4	3.1	—	13.5	7.8	4.4	—	31.4	46.7	28.3	32.1	
(b) peat	—	2.9	3.7		—	2.2	2.3	—						
Mean calculated yield in gantangs per acre (a)	**Nil**	**260**	**350**	**155**	**Nil**	**560**	**325**	**185**	**Nil**	**1300**	**1925**	**1170**	**1330**	
(b) peat	**Nil**	**137**	**150**	**Nil**	**Nil**	**90**	**90**	**Nil**						
Ratio mean grain/straw	—	0.32	0.41	0.22	—	0.48	0.42	0.24		0.65	0.80	0.72	0.86	
Ratio mean grain/stalk	—	0.88	0.84	0.70	—	0.98	0.94	0.30		1.33	1.18	1.47	1.10	
Percentage increase cf. 1933	—	—	—	—	—	—	—	—		30	92	17	33	
Significant difference (a) between treatments (gantangs) (b) peat		474				510					320			
Remarks on (a) Growth	Very poor	Poor	Poor	Poor	Good	Medium	Medium	Medium		Good	Very good	Good	Best	
(b) Stalks	Thin	Thin	Thin	Thin	Thick	Thick	Thick	Thick		Thin	Thick	Thick	Very thick	
Percentage of empty glumes (a)	—	4.28	16.3	9.4	—	8.32	5.7	5.12		1.7	5.92	4.27	1.91	
(b) peat	17.3	2.6	2.82	3.86	—	—	—	—						

Field estimate 1,000 gantangs

Note:—There was no manurial treatment in 1933.

Table II (*Continued*)

Factor	No Green Manurial Treatment													
	Penang									Malacca				
	10 cwt. Ground Horn *	40 cwt. Ground Horn *	10 cwt. Ground Horn * 10 cwt. CaMg	10 cwt. Ground Horn * 40 cwt. CaMg	10 cwt. Ground Horn * 10 cwt. Silicate	40 cwt. Ground Horn * 10 cwt. Silicate	10 cwt. Ground Horn * 10 cwt. CaMg 10 cwt. Silicate	10 cwt. Ground Horn * 40 cwt. CaMg 10 cwt. Silicate	1933	2 cwt. Form : Urea. 30 cwt. Super *	30 cwt. Form : Urea. 30 cwt. Super *	2 cwt. Ammonium Sulphate 30 cwt. Super	30 cwt. Ammonium Sulphate 30 cwt. Super	1933
Mean tillers at 2 months	10.6	12.1	11.1	12.6	13.1	12.3	12.7	11.7		5.25	12.68	5.92	3.58	1.98
Mean tillers at harvest	10.75	12.75	11.75	11.65	11.75	16.25	11.9	16.3		4.42	18.6	4.08	8.77	2.49
Mean height at 2 months	56″	55″	54″	53″	51″	57″	61″	53″		41″	51″	41″	37″	30″
Mean height at harvest	78″	80″	79″	73″	80″	85″	81″	76″		50″	69″	46″	49″	39″
Mean spikelets per tiller	10.7	11.3	10.5	11.9	16.7	9.6	9.7	7.7		10.1	10.0	10.0	9.1	3.84
Mean weight in grams of grain per plant (a)	56.1	62.1	41.4	51.5	56.1	62.1	41.4	51.5		13.3	58.0	9.5	19.7	
(b) peat	—	—	—	—	—	—	—	—		—	—	—	—	
Mean calculated yield in gantangs per acre (a)	**2385**	**2565**	**1740**	**2120**	**2110**	**2540**	**1715**	**2140**	**1000**	**550**	**2430**	**390**	**817**	**377**
(b) peat														
Ratio mean grain/straw	1.00	1.12	0.75	1.02	0.78	0.99	0.72	0.70		0.95	0.97	0.78	0.75	
Ratio mean grain/stalk	1.02	1.18	1.10	1.58	1.41	1.31	1.16	1.85		2.29	0.93	1.48	0.91	
Percentage increase cf. 1933	138	156	74	112	111	154	71	114		46	545	3.5	117	
Significant difference between treatments (gantangs) (a)		1440				1240					138			
(b) peat														
Remarks on (a) Growth	Very good	Very good	Good	Very good	Very good	Very good	Very good	Very good	Field estimate, plots not available	Fairly good	Very good	Very good	Very good	
(b) Stalks	Very thick	Very thick	Thick	Thick	Thick	Very thick	Very thick	Very thick		Thin	Thick	Thin	Thick	
Percentage of empty glumes (a)	2.30	4.67	0.73	5.58	1.47	1.98	0.75	1.2		6.34	3.23	6.22	1.63	
(b) peat	—	—	—	—	—	—	—	—						

* It must be remembered that with these insoluble nitrogen compounds 10 cwt. etc. means a quantity containing the same amount of nitrogen as 10 cwt. etc. of ammonium sulphate.

Note :—There was no manurial treatment in 1933.

Table II (*Continued*)

Factor	No Green Manurial Treatment									
	Titi Serong					Selinsing				
	2 cwt. Form : Urea	30 cwt. Form : Urea	2 cwt. Ammonium Sulphate	30 cwt. Ammonium Sulphate	1933	2 cwt. Humic Acid *	20 cwt. Humic Acid *	3 cwt. Am. Sulph. 30 cwt. Super 22 cwt. Potash	3 cwt. Am. Sulph. 30 cwt. Super 22 cwt. Potash 30 cwt. CaMg	1933
Mean tillers at 2 months	5.72	9.59	6.34	5.51	2.87	5.67	7.0	6.67	12.85	1.27
Mean tillers at harvest	5.84	12.0	6.25	8.5	2.73	6.08	5.92	9.9	16.5	2.75
Mean height at 2 months	44″	47″	45″	45″	33″	46″	42″	48″	51″	16″
Mean height at harvest	52″	72″	57″	62″	41″	57″	69″	64″	74″	49″
Mean spikelets per tiller	12.5	10.2	9.1	10.4	3.58	11.5	10.8	10.8	8.4	4.34
Mean weight in grams of grain per plant (a)	23.9	51.7	16.7	43.3		25.5	17.4	38.8	58.6	
(b) peat	—	—	—	—		—	—	—	—	
Mean calculated yield in gantangs per acre (a)	**995**	**2170**	**695**	**1800**	**403**	**1060**	**720**	**1610**	**2415**	**527**
(b) peat										
Ratio mean grain/straw	1.15	1.04	0.78	1.23		0.89	0.80	1.05	1.12	
Ratio mean grain/stalk	2.07	1.69	1.90	1.81		2.31	2.32	1.86	2.74	
Percentage increase cf. 1933	147	435	72	350		101	37	206	360	
Significant difference between treatments (gantangs) (a)		810					1120			
(b) peat										
Remarks on (a) Growth	Fairly good	Very good and	Poor	Best		Medium	Medium	Good	Best	
(b) Stalks	thick	Large thick	Thin	Very thick		Thick	Thick	Thick	Thick	
Percentage of empty glumes (a)	7.22	3.23	8.98	3.9		2.5	2.03	1.63	2.8	
(b) peat										

* It must be remembered that with these insoluble nitrogen compounds 10 cwt. etc. means a quantity containing the same amount of nitrogen as 10 cwt. etc. of ammonium sulphate.

Note :—There was no manurial treatment in 1933.

1933 are taken as standards with which to compare the yields obtained this year. The figures for the yields are given in gantangs per acre for convenience of visualization of the type of yield being obtained and they are also given as a percentage increase or decrease compared with 1933.

The results obtained are very striking; full details of these are given in Table II. For convenience, details of the 1933 figures are added. Table II only applies to those pots with normal lighting. In addition, this year the table shews the percentage by weight of empty glumes. It is interesting to note that in general the poorer the yield the larger is such percentage.

It seems advisable to discuss the effect of different fertilizers under their different heads, but there appear to be certain general comments to make.

(i) The effect of peat is greatly to depress the yield even when the addition of raw peat amounts to only 2 per cent. of the top six inches of soil. With gradually increasing amounts up to 8 per cent. the effect is increasingly marked.

(ii) The response to *increasing* dressings of phosphate alone from 10 to 60 cwt. superphosphate has been very little, but for 10 cwt. only has been considerable.

(iii) The response to heavy dressings of nitrogen both soluble and insoluble has been very great.

A. The Phosphate Effect.

(1) *Alone.*

Taking firstly the rows to which phosphate only had been added, *i.e.* Lenggong Row 1, Kamunting Row 1 and Kuala Lumpur Row 1, it will be seen that the significant differences between any two treatments are 650, 270 and 474 gantangs per acre respectively, so that there is no significant difference between 10, 20, 40 and 60 cwt. of P ($_5$ as far as Lenggong is concerned (though there is a fall with increased P_2O_5), and that in the case of Kamunting there is a gradual drop in yield with increasing amounts of superphosphate so that 10 cwt. is actually just significantly better than 60 cwt. It must be noted, however, that in the case of Lenggong the *increase* in yield compared with the control year of 1933 varies from a minimum of 80 per cent. to a maximum of 148 per cent.; such figures seem likely to be due to heavy dressings of phosphate. In the case of Kamunting the increases are between 40 and 240 per cent.

In the case of Kuala Lumpur (Hill Quartzite) there is an increase in yield from 10 to 20 cwt. of superphosphate though this is not significant, but at 40 cwt. the yield again drops away. The percentage increase compared with the control year cannot be calculated, as no yield was obtained in 1933. It should be noted that three seasons' treatment under anaerobic conditions only does not seem to have made any marked improvement in the first four pots of Kuala Lumpur soil, these pots shewing poor growth and no yield.

(2) *With Silica.*

The only trial made with P_2O_5 and silica was on Kuala Lumpur soil. In this case there was the same falling off in yields between 10, 20 and 40 cwt. super-

phosphate, (the silica being the same throughout 10 cwt. "water glass") but the yield was double in the case of 10 cwt. superphosphate and silica and the same in the case of 20 cwt. compared with phosphate only. This is further discussed under silica.

(3) *With Potash.*

Here again where 10 and 40 cwt. of superphosphate were each tried with 7 and 30 cwt. of potash, there is little to choose between 10 and 40 cwt. as far as the phosphate is concerned.

(4) *With Calcium and Magnesium.*

For this purpose the rather poor Kuala Pilah and Kamunting soils were used, and 10 and 30 cwt. of superphosphate were compared with and without corresponding amounts of calcium and magnesium. The results obtained were remarkable in the case of Kuala Pilah as the addition of 10 cwt. superphosphate alone gave an increase of 810 per cent. over the control year figure of 220 gantangs, the actual figure being 2,020 gantangs. Again, the heavier dressing of phosphate alone had a depressing effect and it would appear that the effect of the phosphate was the same in combination with calcium and magnesium.

In the case of Kamunting the comparison in each case was between combinations of 10 and 40 cwt. calcium and magnesium mixtures and superphosphate. Again the depressing effect of the heavier dressing of phosphate and the excellent effect of 10 cwt. is to be noted, the yield being 1,300 gantangs or 210 per cent. increase for the latter case.

(5) *With Insoluble Nitrogen.*

In comparing 10 and 40 cwt. of superphosphate in combination with 10 and 40 cwt. of insoluble nitrogen (with Raub good soil) much the same type of result is obtained, the comparative dressings of 40 cwt. nitrogen with 10 and 40 cwt. superphosphate being identical, while the 10 cwt. nitrogen with similar phosphate shews a rather slighter effect for the heavier dressing. Owing to the phosphate dressing being the same throughout, in the case of Malacca soil no consideration can be taken of the P_2O_5 which was added as a dressing for the comparison of different nitrogenous manures. From observations on phosphates made above it would appear that Malacca might have shewn even better results for nitrogen had the superphosphate been reduced to about 10 cwt.

To sum up, it appears that increases far beyond the "bar" can be obtained with phosphates. The optimum dressing appears to be of the order of 10 cwt. superphosphate. This does not imply that the maximum phosphate dressing is 10 cwt. but it is possibly the order of the optimum for an acid manure (see humic acid below).

B. Nitrogen.

By far the most important results obtained this year have been in connexion with nitrogen, and although increased vegetative growth is nearly always observed with a nitrogenous manure, yet no result has so far been obtained above the "bar" in this country. The results here recorded, therefore, are of unusual interest and importance.

(1) *Insoluble Nitrogen.*

(*a*) Ground Horn (18 per cent. N.).

The first two lots of Penang soil pots were treated with 10 and 40 cwt. of insoluble nitrogen in the above form. The response was excellent, the yields being 2,385 and 2,565 gantangs, increases of 138 and 156 per cent. respectively. As the standard error was large there is no significant difference between these two results.

(*b*) Formaldehyde Urea (23 per cent. N.) (Referred to in text as form: urea).

This was applied to two lots of Titi Serong soil at the rate of 2 and 30 cwt. and the yields were 995 and 2,170 gantangs shewing increases of 145 per cent. and 435 per cent. The difference is significant but yields in the second case are not commensurate with the extra nitrogen added.

(*c*) Humic Acid (4.5 per cent. N.).

This was applied to two lots of Selinsing soil at the rate of 2 cwt. and 20 cwt. It should be remembered that these applications at "2 cwt. etc." are quantities containing the same amount of nitrogen as 2 cwt. of the standard ammonium sulphate, so that a fairly large quantity of humic acid was involved, approximately five times the weight of ammonium sulphate. The results obtained from 2 and 20 cwt. were 1,060 and 720 gantangs—increases of 100 and 37 per cent. respectively. The result, though differing from horn and form: urea, is not altogether unexpected as the large amount of acid added in the second case may have materially affected the soil bases, but here again the effect of nitrogen in an insoluble form is still apparent.

(2) *Insoluble Nitrogen in Combination.*

(*a*) Form: urea + Superphosphate.

This combination was tried out on the Raub high-yielding soil, 10 cwt. of form: urea combined with 10 and 40 of superphosphate and 40 cwt. of form: urea combined with 10 and 40 of superphosphate.

The results were in conformity with those discussed above. The 10 and 10 combination gave 1,300 gantangs, the 10 P and 40 N gave 1,925 gantangs, the 10 N with 40 P dropping to 1,170, again illustrating the rather depressing effect of excessive acid phosphate, the 40 and 40 mixture was slightly better at 1,330 gantangs. In terms of percentage increase the figures give 30, 92, 17 and 33 respectively. The notable effect of insoluble nitrogen is not actually so marked as with nitrogen alone.

In the case of Malacca soil the phosphate dressing was kept at 30 cwt. throughout, a figure which, from the general results obtained this season, appears to be too high and it is, therefore, probable that more striking results would be obtained with less phosphate. The yields for 2 and 30 cwt. of form: urea were 550 and 2,430 respectively showing increases of 46 and 545 per cent. It appears that the heavier nitrogen probably counterbalanced the too heavy phosphate to some extent, a conclusion to be derived also from the Raub good soil.

(*b*) Ground Horn and Silica (10 cwt. Sodium Silicate).

For this purpose the second row of Penang soil was used, but only in com-

bination with 10 cwt. of ground horn did it give a positive result, when the figure of 2,110 gantangs was obtained. With 40 cwt. of horn it gave the same as horn alone and in combination with horn, calcium and magnesium it gave the same as horn, calcium and magnesium alone. It would thus appear that all effect was due to horn.

(*c*) Ground Horn with Calcium and Magnesium.

This treatment also was carried out on Penang soil. There was a drop compared with 10 cwt. horn alone from 2,385 to 1,740 gantangs (27 per cent.) with 10 cwt. of mixed calcium and magnesium salt, while with 40 cwt. of each the yield dropped from 2,565 for 40 cwt. of horn alone to 2,120 gantangs.

C. Comparison of Soluble with Insoluble Nitrogen.

The marked differences during growth have already been discussed under that heading. The two soils used for this comparison were Malacca and Titi Serong. The former received a dressing of 30 cwt. of superphosphate throughout, the latter nitrogen alone. It has been remarked above that Malacca probably shews a depressed effect due to excess of superphosphate. Nevertheless, the observations made during growth were amply confirmed at harvest.

For Malacca 2 cwt. form: urea gave 500 gantangs; 2 cwt. of ammonium sulphate gave 390; 30 cwt. form: urea gave 2,435, while 30 cwt. ammonium sulphate gave 817 gantangs. The significant difference was 138 gantangs.

In the case of Titi Serong 2 cwt. form: urea gave 995 against 695 for 2 cwt. ammonium sulphate; 30 cwt. form: urea 2,170 against 1,800 for 30 cwt. ammonium sulphate.

The results thus obtained are interesting in view of the observations made on soils kept under anaerobic conditions in the laboratory, to be described in the next issue.

To sum up the observations on nitrogen, it would seem that yields well above the "bar" can be obtained with this dressing alone* if present in sufficient quantity; with fairly small quantities in insoluble form; with large quantities in the form of ammonium sulphate. Ground horn is the only one of those tried which has any practical possibility and the question of costs and supplies is being further considered.

D. Calcium and Magnesium.

These have already been considered in combination with nitrogen and phosphates but the observations were confined to the other element present.

(1) *With Phosphate.*

With Kuala Pilah soil the calcium-magnesium mixture was tried with superphosphate in combination 10 and 10, 30 and 30 cwt. With 10 cwt. the yield was less by 28 per cent. than with 10 cwt. phosphate alone. With 30 cwt. this was reversed, the yield being 50 per cent. higher than with the corresponding amount of phosphate alone. On Kamunting the corresponding combinations were 10 and

* Economics are not to be considered here. The object in the first place is to get above the "bar".

10, 40 and 10, 10 and 40 and 40 and 40 for phosphate and calcium-magnesium respectively. In each case, with the exception of 10 and 10, the yield was less than phosphate alone. The higher dressing gave the poorer result.

(2) *With Nitrogen.*

For this purpose Penang soil was used and nitrogen was in the form of ground horn. The combinations were 10 and 10, 10 and 40 for nitrogen and the calcium-magnesium mixture respectively. In each case the yield was less than with nitrogen alone.

(3) *With a Complete Heavy Dressing.*

On Selinsing soil 30 nitrogen, 30 superphosphate and 22 potash was tried without and with 30 calcium-magnesium mixture. The respective yields were 1,610 and 2,415 gantangs. Here the increase of the latter over the former is marked, being just 50 per cent.

From this it would seem that results are somewhat inconclusive but on the whole the evidence is in favour of non-utility of such a calcium-magnesium mixture.

E. Silica.

In the previous year, as already stated above, the addition of 10 cwt. of sodium silicate gave nine positive increases out of thirteen trials.

In the case of Penang soil in all combinations (*i.e.* with 40 cwt. of horn and 10 and 40 cwt. of horn + calcium-magnesium mixtures) the results were the same as for those without silica.

On the very poor Kuala Lumpur soil it greatly improved growth as the sole manure, though no crop was obtained. An increase of over 100 per cent. was obtained in combination with 10 cwt. of superphosphate, a slight decrease with 20 cwt. of the latter, and about 20 per cent. increase with 40 cwt. It should be remembered that the higher phosphate repressed the yields.

On the whole, silica seems to be of some importance on a poor soil. It should be stated that all the positive results of 1934 were with considerably smaller quantities of phosphate and nitrogen than were used in 1935.

F. Peat.

The details of the addition of peat are given above. In every case there was a large drop in yield; the percentage drop was considerably greater on the poorer-yielding soils and where too heavy dressings of phosphate had a depressing effect.

G. Complete Heavy Dressings.

Only two sets of Selinsing soil were available for this and they have been commented on under Calcium and Magnesium. The mixture in the one case was 30 cwt. ammonium sulphate, 30 cwt. superphosphate and 22 cwt. potash. This yielded 1,610 compared with 1,060 gantangs for 2 cwt. of humic acid. With the further addition of 30 cwt. calcium-magnesium mixture the yield was 2,415 gantangs.

H. The Effect on Leaf and Stalk.

Although the percentage increase in grain is of prime importance, yet the effect of many of the above dressings on purely vegetative growth was so marked (as will be seen from the photographs) that it is of interest to comment on it.

Taking Malacca and Titi Serong as the outstanding examples where light and heavy, soluble and insoluble dressings of nitrogen were given, the tillering figures are of great interest:—

Mean Tillers per Plant.

	2 cwt. sol.		2 cwt. insol.		30 cwt. sol.		30 cwt. insol.	
	Mal.	Titi Serong	Mal.	Titi Serong	Mal.	Titi Serong	Mal.	Titi Serong
At 2 months ...	5.92	6.34	5.25	5.72	3.58	5.51	12.68	9.59
At harvest ...	4.08	6.25	4.42	5.84	8.77	8.5	18.60	12.0

These figures suggest that there was not enough nitrogen available through the season with the lighter dressing either of insoluble or soluble.*

The extraordinary heights to which some of the padi grew (7 feet 3 inches maximum) has already been mentioned. It was found that the higher the padi grew the greater was the tendency for lodging to take place. In general, the better the crop the taller the padi. It should be noticed that at two months the increase in height compared with the control year is anything from 15 to 200 per cent., and at harvest anything up to 70 per cent. higher. The increase in tillering is about 100 per cent.

Nitrogen was determined on leaves and stalks for each manurial series in triplicate, but no correlation was found between the nitrogen content and weight of leaf or stalk.

J. Results from Artificial Lighting.

Remarks have already been made on general growth differences between normal and artificially-lighted padi. The results in yield have been entirely different. With artificial light a very large percentage of the ears were completely empty, while almost all ears turned a reddish brown on ripening.

Individual comparison is made below.

Phosphate Alone.

Kuala Pilah soil. With 10 cwt. of superphosphate a total yield of 695 gantangs was obtained, but 55 per cent. of this had empty glumes. This compares with 2,020 gantangs for normal lighting.

* For remarks on number of tillers, see page 330.

TABLE III

The Effect of Artificial Lighting.

Soil and Treatment	Yield in Gantangs (measured) (a) full glumes	(b) empty glumes	Soil and Treatment	Yield in Gantangs (measured) (a) full glumes	(b) empty glumes
KUALA PILAH 4 TONS G.M.			KUALA PILAH PEAT		
(a) 10 cwt. P_2O_5	395	300	as (a) ½ Kgm. peat	145	645
(b) do. 10 cwt. CaMg	135	1240	as (b) 1 „ „	110	1290
(c) 30 cwt. P_2O_5	305	600	as (c) 1½ „ „	340	1550
(d) do. 30 cwt. CaMg	405	1160	as (d) 2 „ „	308	1290
TITI SERONG			RAUB HIGH-YIELDING		
2 cwt. form: urea	495	1960	10 cwt. P_2O_5 10 cwt. form: urea	555	615
30 cwt. „ „	610	600	„ „ 40 cwt. „	358	830
2 cwt. am. sulphate	450	935	40 cwt. „ 10 cwt. „	290	355
30 cwt. „ „	415	310	„ „ 40 cwt. „	640	580
SELINSING			MALACCA 30 cwt. P_2O_5		
2 cwt. humic acid	415	900	2 cwt. form: urea	280	355
20 cwt. „ ...	335	395	30 cwt. „ „	195	515
30 cwt. P_2O_5 30 „ cwt. am. sulphate			2 cwt. am. sulphate	210	545
22 cwt. K_2SO_4	605	815	30 „ „ „	380	335
- do. - - do. - + 30 cwt. CaMg	570	415			
LENGGONG 4 TONS G.M.			LENGGONG PEAT		
(a) 10 cwt. P_2O_5	735	515	as (a) ½ Kgm. peat	450	20
(b) 20 cwt. „	610	860	as (b) 1 „ „	305	10
(c) 40 cwt. „	695	730	as (c) 1½ „ „	430	40
(d) 60 cwt. „	460	370	as (d) 2 „ „	535	45

In the case of Lenggong soil, comparisons were made with 10, 20, 40 and 60 cwt. of superphosphate. It will be seen that in each case the yield is very much smaller for the artificially lighted padi and that, in addition, the percentage of empty glumes varies between 40 and 60 per cent. In those pots to which peat had been added drop in yields was not pronounced but the percentage of empty glumes was only between three and nine per cent.

Phosphate and Nitrogen.

On Raub high-yielding soil the yields varied from 70 to 50 per cent. of the normal lighted pots with about 50 to 70 per cent. of empty glumes.

Form: urea. Complete Heavy Dressing and Phosphates with Calcium and Magnesium, Humic Acid.

In each case the artificial lighting caused a drop of from 30 to 50 per cent. in yield with about 50 to 70 per cent. of empty glumes.

It is of interest to compare the results obtained with those of Yataka Fuke whose paper has already been mentioned. He found that (i) increase in the growth period was roughly proportional to the number of days of artificial illumination, (ii) the delay period varied with the variety, (iii) with some varieties flowering took place while undergoing artificial light treatment, (iv) with some varieties no flowering took place as long as artificial lighting was continued.

In no case, however, is any mention made of empty glumes or other abnormality of the padi obtained.

Etiolation Experiments.

It has recently been found that by etiolation the maturation period of maize can be shortened sufficiently in temperate climates for it to mature during the summer months with long daylight. (In Malaya with its short day the maturation period is only three months).

It therefore seemed possible that a heavy-yielding Seraup padi with an eight months maturation period might have its growth period shortened by etiolation.

On the suggestion of the Chief Research Officer, S.S. and F.M.S., a small amount of a Seraup padi was etiolated for nine days and was then planted out in different soils side by side with a Radin.

For reasons of space it was found necessary to place the pots for this experiment close to the illuminated cage and the effect of this was undoubtedly to cause a certain amount of extra vegetative growth owing to the reflected light, so that the Radin flowering was retarded by nearly two months. The Seraup, however, flowered at the same time so that there was apparently some decrease in the maturation period. As this was initiated in the middle of the padi season it was not possible to lay down a fully controlled experiment and the result obtained is only of a preliminary nature.

Soil under Fallow.

Since the harvest has been completed it is very noticeable that there are great differences in the weed growth in the different soils after drying out. This applies both to quantity and species. A casual examination seems to shew that for

a given soil the growth is consistent in every pot and that the richer soils have the sturdier growth. At the time of writing, an ecological examination is being carried out which will be incorporated in the next report.

Comments.

One point of great importance in a consideration of these results is the actual quantity of grain per plant. Field experience has shewn that the number of tillers per hill has a tendency to be constant whatever the number of plants. Turning to the actual figures *per plant* in these experiments it will be seen that they are low, while tillers are also lower than field numbers. On the other hand, the space occupied by the three plants in the pot is only twenty-four per cent. more than occupied by one "hill" in the field (12 inches by 12 inches planting) which may consist of one, two or three or even more plants per hill. As it has been found in the latter case that the tillers per hill tend to a constant number it seems most probable that the three plants per pot should only be regarded as occupying one hill. In this connexion the figures given for variation in tillering with planting distance in the *Malayan Agricultural Journal* for December 1933, page 637, are of interest where, for planting distances of 15 inches, 12 inches and 9 inches square respectively, the tillering numbers at harvest are of the order 15, 12 and 8 so that with a planting distance of $7\frac{3}{4}$ inches a figure of 6 would appear to be about normal.

The object of pot experiments such as these is to indicate the lines which future trials should take and to show where the more positive results are likely to be obtained.

The balance of evidence is that yields obtained were in effect a good measure of the efficacy of the treatments tried out, but, even if this is so, it seems unlikely, unless the price of the materials used is very considerably lowered, that such dressings have any immediate possibilities. It is essential, however, that this particular sphere should be more closely examined in order that complete conclusions can be drawn.

Certain further lines of investigation in pots are indicated to answer the following questions:—

(1) Have these high dressings of insoluble nitrogen and/or acid phosphate a sufficiently large residual effect to bring their use within economic limits.

(2) What is the minimum nitrogen dressing either soluble or insoluble which will bring yields well above the "bar" (No trials were made between 2 and 20 cwt. of soluble or between 2 and 10 cwt. of insoluble nitrogen).

(3) A large amount of data is now available on dressings between 1 and 3 cwt. and results are shewn here between 10 and 60 cwt. of phosphates. Would dressings of basic phosphate or the comparatively cheap rock phosphate dust between 4 and 10 cwt. have the desired effect of raising yields above the "bar" and have such dressings any residual effect of economic worth.

(4) The question of green matter requires further investigation. Extensive experiments have been carried out with green matter buried and left on the surface but all such experiments have only been carried out with green matter grown *in situ*. The so called 'batas'* effect may be due to a concentration of nitrogen along the edge of the batas but it must be borne in mind that the batas is made up from green material grown over a large area and not that in the immediate vicinity.

It must be decided whether any quantity of green matter, however high, will raise yields above the bar.

(5) Can nitrogen in a cheap soluble form be successfully added to the irrigation water at the padi field intake, to form a constant supply of available nitrogen.

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* Batas = small bund made up from green matter grown in the padi field during the non-padi season.

Batas effect.—It is usually noticeable that padi growing close to the batas gives a higher yield than that growing in the centre.

COPRA MANUFACTURE.

Part II—Kilns of Intermediate Size.

BY
F. C. COOKE,
Officer-in-Charge of Copra Investigations.

Introduction.

In the first of this series of articles,* two small and inexpensive copra kilns of wooden construction were described. Sufficient time has now elapsed, since this account appeared, to show that either of these kilns will give good results in the hands of small-holders if the coconuts are split at the kiln side and converted without delay into copra. Nevertheless it has been found that neither of the two kilns has aroused any considerable degree of interest.

It has emerged that the "30 acre" kiln with a capacity for 350 nuts and, depending on local circumstances costing between $10 and $20 to build, is regarded as being large enough only for properties of less than 3 acres, while the "10 acre" kiln is generally considered to be much too small.

It now appears that the new type of small copra producer who has started manufacturing copra himself, almost invariably requires a kiln for much less frequent use than the middleman or shop-keeper copra producer whom he is replacing, and whose kiln, operated on bought nuts, is generally in regular use. The standard harvesting procedure on small holdings is to collect the whole of the crop once every two months. If the holding is small, the nuts may be brought in whole and husked at the kiln side, but on slightly larger properties where nuts have to be carried in bags or where nuts are brought in from surrounding holdings, they are received at the kiln side in a split condition and must therefore all be dried without delay.†

Where the same men collect, husk and split the nuts, and later dry the copra, it is obvious that the kiln must be of such a size that the whole of one day's collection of split nuts can be loaded on to the kiln the same day, irrespective of whether the copra is dried slowly on the crude kilns or rapidly on the new kilns.

A survey of some 40 kilns in one important coconut district provides the data tabled below regarding copra driers of all sizes and condition used on properties of various sizes.

It will be noted that kilns for the small acreages require to be disproportionately large when compared with the kilns for the larger properties and also that there are no kilns, even on the smaller properties, with a capacity of less than 500 nuts.

* *Malayan Agricultural Journal*, Vol. XXIV, April 1936, page 167.
† *Malayan Agricultural Journal*, Vol. XX, July 1932, page 351.

No. of Examples	Nut Capacity of Kiln	Usual Cost of Kiln	Usual Acreage of Coconut Land. Owner. Suppliers. Total.
6	500 to 600 nuts	Nil to $ 5	2 + 1 = 3
8	700 to 800 ,,	Nil to $10	3 + 5 = 8
6	1000 to 1500 ,,	Nil to $30	5 + 15 = 20
6	2000	$ 5 to $200	Various = 30
6	3000	$10 to $250	Various = 50
1	5000	$380	20 + 60 = 80

At the present time, the typical 3 acre small-holder, having a crude kiln with a capacity of say 600 nuts, need only load his kiln once or perhaps twice every two months according to the crop to be dealt with and he will obtain saleable, if under-dried and poor quality, copra with only about a week's work, inclusive of collection and preparation.

With an improved kiln, having a capacity of only 100 nuts, he would have to devote ten to twelve days to drying alone, and this he is not prepared to do even to obtain better copra.

It is apparent from the preceding table that the so-called "30 acre" kiln, with a capacity of 350 nuts, is actually only best suited to 1 to 3 acre properties, the owners of which are at present mostly selling their nuts to the Chinese or Malay owners of large kilns. The owners of such small properties, however, generally lead a hand-to-mouth existence and cannot afford the money necessary to build a plank kiln, costing even as little as $10.

It follows, from the foregoing, that the system of naming kilns on the basis of maximum mature acreage and regular operation is unsatisfactory. Nut capacity as an indication of the size of a kiln can also be misleading, since the old type of smoke kiln requires three days to produce dry copra, while the new kilns, requiring only one day, have an operating capacity three times as great as their total nut capacity indicates.

In order to prevent confusion it has been decided to adopt a system of numbering for the various kilns based on acreage and nut capacity. The new numerical designations indicate directly, more particularly in the case of the smaller kilns, the acreage of good coconuts for which such kilns can be regarded as suitable with intermittent operation; they can also be used to determine the approximate nut capacities of the several kilns by multiplying the various reference numbers by one hundred, while the acreage of good mature coconuts which the kiln could serve, if operated regularly, is obtained by multiplying by ten.

The original "10 acre" kiln will in future, be known as kiln Type 1, and the "30 acre" kiln as Type 3. Similarly other recently proved models are kilns Types 4, 5, 6, 7, 8 and 15. It will be seen that the new system is capable of extension whenever fresh types are satisfactorily evolved.

Kilns of Intermediate Size.

A number of larger kilns operating on the same principal as kiln Type 3 (the original "30 acre" kiln) have been built and tested.

In the light of what has been written previously, it seems probable that the various needs of individual small-holders will be satisfactorily met by one of these larger kilns, and where a kiln is required for regular use, the largest of these—kiln Type 15—will be found equally suitable for an individual working a 100 acre coconut estate, or for grouped production by a co-operative society, a syndicate, or by a large buyer of coconuts.

The following three types are described in detail:—

Type 7—An enlarged single chamber kiln with room for two fires burning simultaneously.

Type 8—A twin kiln consisting of two Type 3 kilns built together, with a common dividing wall.

Type 15—A twin kiln consisting of two Type 7 kilns built together, similarly to Type 8.

These kilns have, in trials, given white dry copra, without any preliminary sundrying, in 24 hours or less.

Kiln Type 7.

This kiln, which can dry between 700 and 800 nuts per day, is an enlargement of the standard Type 3 kiln and must be regarded as suitable for small-holders who own or are able to obtain the crop from between 3 and 10 acres of coconuts.

It has been found that the Type 3 kiln may satisfactorily be made wider and longer, without affecting the high performance of this new design by

(a) raising the copra grill 12 inches, and

(b) by having two fires in the fire-pit.

It has been shown by experiment that, with a 7 foot fire-pit, the effective hot zone in the bed of copra immediately over a double-shell fire is covered by a circle 5 feet in diameter. This fact determines the width of a kiln with a 7 foot fire-pit.

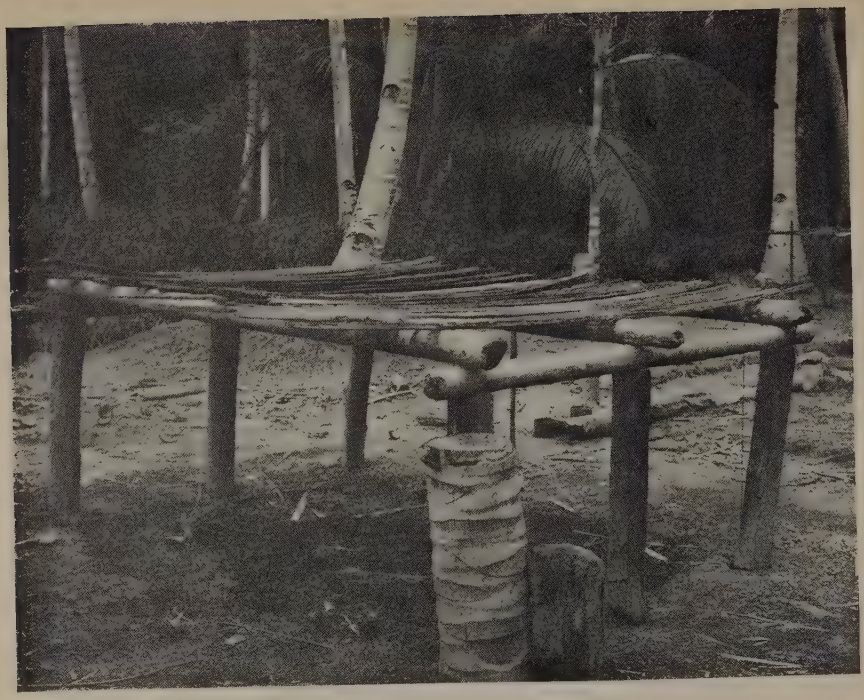
It has been found* satisfactory to have two fires, one burning from each end of the kiln inwards towards the centre, providing one chain is twice as long as the other. Both chains are lit at the same time in the wing extensions of the kiln, but the fires never meet since one fire goes out before the other. Thus the copra grill may be lengthened from 6 feet using one fire, to 10 feet with two fires.

A refinement which is possible with the 7 foot fire-pit, since there is sufficient headroom, is the use of a heat spreader. The spreader consists of a piece of flat sheet iron which is placed directly over the centre of the hearth. Since the centre of the travelling circle of heat is hottest, this heat spreader serves to make

* It must be noted that it is not safe in these high-speed smoke-drying kilns to increase the number of fires beyond two, since, with three or more short fires in line, the fires at both ends of the line are attracted towards the middle fire or fires which mount up dangerously and scorch the copra, while elsewhere the material remains cold.

Under Construction.

The Finished Kiln.
Ventilation was arranged after this photograph was taken.



Primitive Copra Kiln.

Typical Kampong Kiln.
Showing smoky, disturbed fires.

temperature conditions within the kiln still more uniform and is conducive to greater efficiency.

The heat spreader, which is 10 feet long and 6 inches wide, is securely suspended one foot below the copra grill, *i.e.* 6 feet above the hearth, and so extends down the centre of the kiln.

Description of the *Samai* Kiln Type 7.

General Arrangement.—The copra platform, 10 feet long and 5 feet wide, consisting of a grill of split nibong, is arranged 7 feet above ground level. The fire-pit is made 6 feet longer than the copra platform by means of two wing extensions, which give more room in the fire-pit, and so allow a long chain of coconut shells to be used. General details of construction and arrangement of doors and openings are the same as for the Type 3 kiln.

Walls.—The vertical walls of the kiln are composed of *samai* matting (*kajangs*), made of nipah leaflets, laid flat and stitched with rotan fibre. The matting is first tacked in position on the timber framework of the kiln and then secured by horizontal laths of split areca palm trunks. This type of matting is so air-tight that some provision for ventilation is necessary.

Roof.—The main roof, covering the 4 feet high box of the copra platform, is of *atap* with open eaves, while the wing extensions are roofed with flat galvanized iron covered with *atap* so arranged on a wooden frame as not to come in direct contact with the warm metal. This precaution is not on account of any fire risk but because *atap* is very friable after being scorched.

Hearth.—In this instance, the hearth was built of home-made bricks*, produced from non-peaty clay of a type obtainable in some of the coconut areas of the west coast of Malaya.

The bricks are arranged in two parallel lines as in the "30 acre" kiln, four bricks high, spaces for air-supply being left between each brick of the bottom row. The total length of the space available for shells is 13¼ feet, the two lines of shells, one 9 feet long and the other 4 feet long, being carefully separated by a barrier four bricks high placed across the hearth. The two ends of the hearth must be only two bricks high.

The shells forming the two chains are fitted loosely into one another with the concavities of each line so arranged that the two fires burn inwards.

Ventilation.—With these larger kilns, particularly when *samai* matting is used for the walls, it is necessary to make provision for ventilation.

This is effected by leaving a 2 inch space between two boards, 6 inches above ground level, at both ends of the kiln. This slit extends the whole width of the kiln. It is screened externally by a plank, while the incoming draught is diverted towards the ground by another plank laid parallel to the first inside the kiln, so that the fires are not disturbed.

The hot humid air from the copra passes out of the kiln through the 9 inch eaves of the *atap* roof.

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* See appendix.

Operation.—The split coconuts are thrown on the copra platform to form a bed 1 foot deep, without any special arrangement, except that the nuts on top are turned face downwards as in the case of kiln Type 3, the description of which should be referred to for minor details of procedure.

Owing to the fact that the grill is arranged at a higher level and that a heat-spreader is provided, it has not been found necessary to reduce the firing, as the copra dries, to avoid scorching the product. As each lot of shells is consumed, it is replaced by a similar arrangement of shells, the only difference being that the longer of the two lines of shell is arranged to burn alternately from each end of the kiln. It is important that an interval of one hour should elapse between the time one set of fires is finished and the next is lighted; this allows the copra to cool a little and reduces the risk of scorching.

The copra should be turned after the second lot of fires is finished in order to bring the dry copra from the bottom of the bed to the top, and so obtain an evenly-dried product.

Each of the sets of fires lasts for about 4 hours, depending on the dryness and the size of the shells used. It has been found that the fires need be renewed only four times, and that, allowing hourly intervals between successive fires, dry white copra can be obtained in 19 hours, providing well-dried shells have been used as fuel and the ground on which the kiln stands has dried out properly.

The kiln has a standard capacity of 750 nuts, 1,080 pieces of half-shell being used as fuel. Thus a considerable surplus of shell is available after every run and good, clean, unbroken shells of even size for use in the fire-pit can be selected.

In the construction of this kiln *samai* matting was used for the walls, *atap* for the roofing, jungle timber for the supports and home-made bricks for the hearth. At the demonstration centre, the cost of this kiln, inclusive of labour transport and materials, was $35, but in the kampong only small items such as the planks, sheet iron, brushes and nails, and also Solignum for use as an external preservative for the *atap* and timbers, need be purchased.

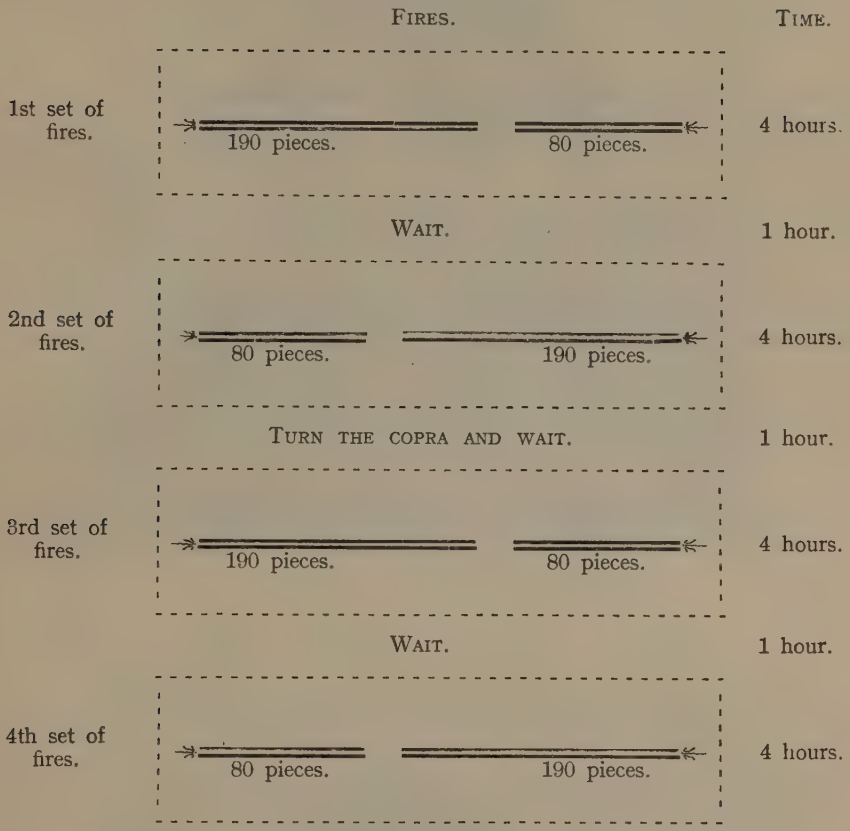
If planks are used throughout, the kiln would cost about $40, inclusive of labour and transport.

Life and Capital Cost.—In spite of the very combustible nature of *samai* matting, the fire risk is negligible unless the operator is careless in bringing burning shell from outside into the kiln, and if the *samai* matting is carefully treated with solignum externally and the posts are also dipped before erection, a life of 3 years may safely be anticipated.

If the kiln is in regular use and operated for 200 days in every year it should be able to deal with 150,000 nuts or 600 piculs of copra obtained from about 70 acres of coconuts. Thus, assuming the kiln is built of planks, instead of *samai* matting, the capital cost spread over two years is equivalent to only 2 cents per picul or 50 cents per acre.

If the kiln is only worked intermittently *i.e.* once every two months, it would treat only about 5,000 nuts per annum, equivalent to 20 piculs of copra, or twice

Operation of Type 7 Kiln.



Overall time	19 hours.
Net firing time	16 hours.

NOTE.—If the night fire is lighted at 9 p.m. and is not renewed till morning, the overall time is 24 hours.

Performance.

No. of nuts dried	750	
No. of shells used	540	
Surplus fuel	210	complete shells.

this quantity if used once monthly. In the first instance a *samai* kiln costing $5 represents a capital charge of 8 cents per picul of copra, or $2 per acre of coconuts.

Details of the Type 7 Kiln.

Cost.

Amount.	Materials.	Approximate Cost.
		$
1 gallon	Solignum ...	2.25
1	Paint brush ...	0.25
12	Areca trees ...	3.60
200	*Ataps* ...	2.00
21 sheets	*Samai* matting 7 ft. x 4 ft. ...	6.30
6 kati	Wire nails (various) ...	0.42
8	Hinges ...	0.32
1 bundle	Rotan ...	0.16
2 pieces	Corrugated iron 8 ft. x 1 ft. 6 in. x 1/32 in. ...	1.80
15	Light poles 20 ft. x 2 in. ...	2.40
2 sheets	Ridging 6 ft. long ...	0.60
4	Meranti planks 16 ft. x 7 in. x 5/8 in. ...	1.00
7	Meranti scantlings 16 ft. x 2 in. x ½ in. ...	0.42
200	Bricks ...	3.00
15	*Atap* sticks ...	0.45
	Total ...	$24.97
	Total, including labour and transport, (approximately)	$35.

Kiln Type 8.*

Like the Type 7 kiln, this kiln is similar in principal to the standard Type 3 kiln. It has, however, nearly three times the capacity of this 350 nut kiln, and a small-holder, owning 10 acres of coconuts, can convert a two-month's harvest of coconuts into copra in 6 to 8 days, while, with continuous working, it can, as its type number indicates, deal with the crop from an 80 acre estate. This kiln is, however, likely to attract most attention among small-holders who can obtain the crop from between 5 and 15 acres of coconuts, part of which crop may be bought or leased.

Description of the Kiln.

General Arrangement.—The kiln may be described as two slightly enlarged Type 3 kilns, placed back to back, and having a common back wall, the design being modified in certain respects to suit this arrangement. Like the Type 3 kiln, it is a closed, *atap*-roofed, plank building. The area covered is 14 feet

* This account is contributed by Mr. C. W. S. Hartley, Agricultural Officer, Perak South.

Under Construction.
Shewing ventilation arrangement and fire passage.

The Finished Kiln.
Shewing the lean-to at rear for shelling and bagging the copra.

Framework of the Kiln.

The Kiln—built of Planks.

by 8 feet and the height to the eaves is 10 feet. The copra platform is 8 feet square and is set at a height of 6 feet above ground level. A plank partition runs longitudinally through the middle of the kiln, thus dividing it into two halves, each with its own fire-pit.

The Fire-Pits.—The fire-pits are each 14 feet long and 4 feet wide and are thus 6 feet longer than the copra platform. Entrance to each fire-pit is by a door 4 feet in height and 3 feet wide, placed at the end of the long side of the kiln. The door of one fire-pit is at the opposite end of the kiln to that of the other. This arrangement allows the two fires to be lighted at opposite ends of the kiln. Screened ventilation through a 2 inch slit may be provided as described previously but is not an essential adjunct.

The Copra Platform.—The platform is composed of nibong slats, overlaid with close mesh wire netting, and surrounded by four plank walls to a height of 4 feet. A pair of double doors in one wall gives access to the platform.

A partition runs longitudinally across the drying platform as a vertical extension of the partition, dividing the two fire-pits. This partition is, however, loose and can be laid flat when the split nuts are being thrown on the half of the platform which lies furthest from the door. A partition across the drying platform is advisable, as it helps to maintain a thorough distribution of the heat from the two fires. Without a partition and with a strong side wind, the heat would tend to be concentrated on one side of the kiln and the copra there might become scorched.

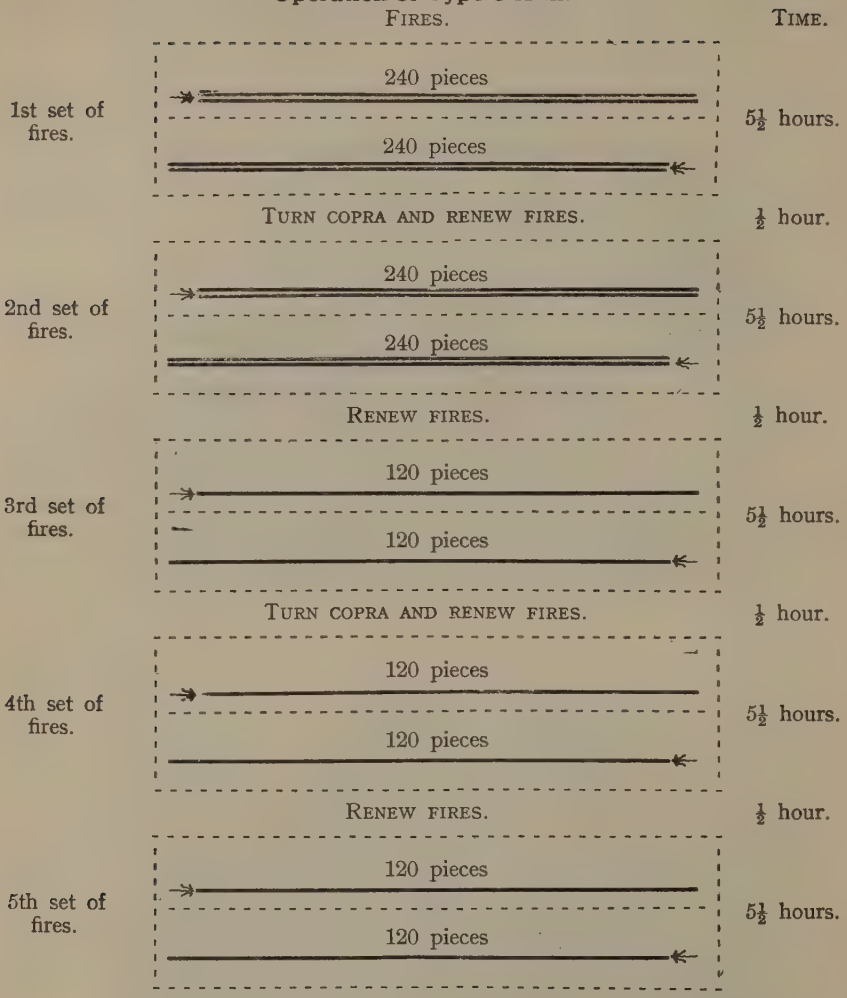
The Roof.—The kiln is covered with an *atap* roof, overhanging 1 foot all round and leaving a gap at the eaves of about 9 inches to permit the escape of humid air. The two sloping roofs of the fire-pit extensions are made of flat galvanized iron covered by *atap*, which must be built on a wooden frame and not laid directly on the hot metal.

Operation.—The operation of this kiln is similar to that of the Type 3 kiln. A double chain of coconut shells, 12 feet long, is laid in each fire-pit between two lines of loose serrated brick work. The nuts are split and thrown on the platform without any special arrangement.

Using good-sized nuts and clean, well-dried shells it has been found that two firings, using double lines of shells, followed by three firings, using single lines of shells, give good results. Thus, good copra can be obtained after 25 to 30 hours drying. The number and intensity of the fires required, however, depends on a number of factors which must be determined independently for each kiln and the most important of which are:—

(a) The number and size of the nuts comprising the charge.
(b) The size of the shells used for fuel.
(c) The dryness of the shells.
(d) The packing of the shells.
(e) The adequacy or otherwise of the ventilation.

Operation of Type 8 Kiln.



Overall time	29½ hours.
Net firing time	27½ hours.

Note.—If the kiln fires are not renewed at night, the overall time is 34½ hours.

Performance.

No. of nuts dried	1,000
No. of complete shells used	840
Surplus fuel	160 complete shells.

Each fire lasts between 5 and 6 hours, the time depending on (b), (c), (d) and (e) above, and the firing requirements being to this extent a matter for experiment.

The copra should be turned after the first and third fires, since good turning results in an evenly dried sample.

Life and Capital Cost.—The materials used for this kiln are the same as those used for the Type 3 kiln. If all the materials are bought new at current market prices, the cost will be about $36. In many localities, however, the small-holder can obtain a large proportion of the materials free or at a greatly reduced cost. The kiln may then cost as little as $14. If a carpenter is employed, the cost will be increased by $8 to $10. Transport costs, if any, will also have to be added to complete the total cost, but these will vary considerable according to the situation of the kiln.

At the Coconut Experiment Station, Port Swettenham, a twin kiln of this size has been constructed satisfactorily of *samai* matting and, on it, 900 nuts were dried satisfactorily in 22 hours overall time (18 hours net) using 1,150 pieces of half shell. The cost of this kiln including labour and transport was $40 but, as most of the materials used, including bricks, can be obtained or made for nothing, the actual cost of the kiln need not exceed $9, including Solignum for preserving the *atap* and timbers.

Details of The Type 8 Kiln.

Cost.

(1) Using new materials at current market prices.

Amount.	Materials.		Approximate Cost
			$
6	Bakau posts at 30 cents	16 ft. x 5 in. ...	1.80
100	*Ataps*	...	1.60
65	Planks at 24 cents	7 in. x $\frac{3}{4}$ in. x 16 ft. ...	15.60
8	Broties at 30 cents	2 in. x 3 in. x 16 ft. ...	2.40
12	Broties at 24 cents	$1\frac{1}{2}$ in. x. 3 in. x 16 ft. ...	2.88
180	Bricks at $1.60 per 100	...	2.88
8	Hinges	...	.24
2 kati	Nails	...	.14
6	Galvanized iron sheets at $1.20	...	7.20
16 feet	Wire netting, at 8 cents per ft., 4 ft. wide	...	1.28
54	Nibong slats from 11 poles at 10 cents	...	1.10
		Total ...	$37.12
	Total cost, including labour and transport (approximately)	...	$45.00

(2) To Small-holders (Estimate).

Amount.	Materials.	How obtained.	Cost
			$
6	Bakau posts	Free from Bakau Reserves ...	—
100	*Ataps*	Free or bought ...	1.50
60	Planks	Obtainable cheap—old or under full length ...	3.60
8	Broties (2 in. x 3 in. x 16 ft.)	Remaining broties obtainable free ...	2.40
180	Bricks	Sometimes obtainable cheap from old buildings or else home-made ...	2.88
8	Hinges	...	—
2 kati	Nails	...	.24
6	Zinc or iron sheets	Flattened old sheets ...	.14
16 feet	Wire netting	...	1.10
54	Nibong slats	Sometimes obtainable locally free	1.28
			$13.14

Kiln Type 15.

This kiln, which can deal with 1,500 to 1,800 nuts per day, consists of two Type 7 kilns built together to form a twin kiln in the same way as kiln Type 8 is a twin of two slightly enlarged Type 3 kilns. While, as its type number indicates, this larger kiln is suitable for an estate of 150 acres it will probably prove most popular among the small-holders who, owning a small plot of coconut land themselves, are able to secure the crops from adjoining properties, totalling in all between 15 and 30 acres.

Details of Kiln.

General Arrangement.—The common partition, dividing the two chambers, is extended upwards eighteen inches above the copra grill and, if required, the part above the grill can be removable in order to facilitate working on the copra platform.

The partition in the fire-pit is not extended laterally into the wings of the kiln which are left freely accessible to allow the fireman to enter the fire-pits of either chamber whenever he wishes. A door is provided at each end of one long wall, while one set of double doors give access to the copra platform.

As in Type 7 kiln, heat spreaders are used, one being required for each section.

Operation.—With the 7 foot fire-pit, double lines of shells can be used throughout the period of drying and no scorching occurs so long as hourly intervals are

Operation of Type 15 Kiln.

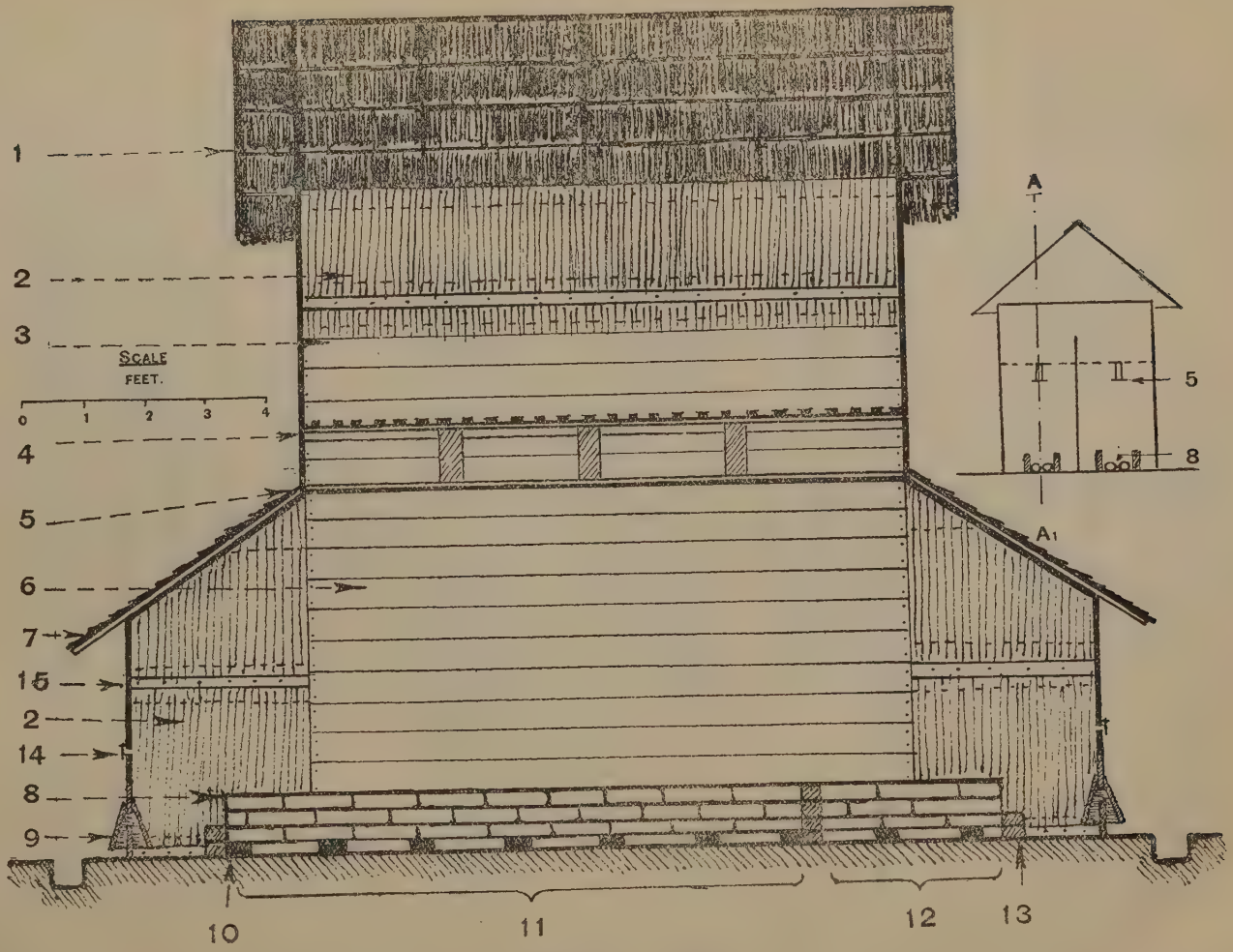
	Fire.	Time.
1st set of fires.	190 pieces / 80 pieces 80 pieces / 190 pieces	4½ hours.
	Wait.	1 hour.
2nd set of fires.	80 pieces / 190 pieces 190 pieces / 80 pieces	4½ hours.
	Turn copra.	1 hour.
3rd set of fires.	190 pieces / 80 pieces 80 pieces / 190 pieces	4½ hours.
	Wait.	1 hour.
4th set of fires.	80 pieces / 190 pieces 190 pieces / 80 pieces	4½ hours.
	Copra off.	
	Overall time	21 hours.
	Net firing time	18 hours.

Note.—If the night fire lighted at say 9 p.m. is not renewed till morning, the overall time is 27 hours.

Performance.

No. of nuts dried	1,500	
No. of complete shells used	1,080	
Surplus fuel	420	complete shells.

Kiln Type 15—with *Samai* Construction.



SECTION A. A1

Details of the Type 15 Kiln.

Cost.

Amount.	Materials.	Size.		Approximate Cost
				$
2 gallons	Solignum		...	4.50
1	Paint brush		...	0.25
75	Meranti planks	16 ft. x 7 in. x 5/8 in.	...	18.75
6	Changai poles	13 ft. x 4 in.	...	13.26
6	Changai poles	6 ft. x 4 in.	...	6.12
20	Broties (teak)	16 ft. x 3 in. x 2 in.	...	8.00
10	Broties (meranti)	16 ft. x 2 in. x 1 in.	...	1.20
55	Broties slats	16 ft. x 1 in. x 1 in.	...	3.30
6	Bakau poles	20 ft. x 2 in.	...	1.50
2	Bakau poles	10 ft. x 4 in.	...	1.20
30	*Atap* sticks		...	1.20
310	Bricks		...	4.65
5 pieces	Flat sheet iron	6 ft. x 1 ft. 6 in. x 1/32 in.	...	3.50
230	*Ataps*		...	2.30
3 bdls.	Rotan fibre		...	0.36
2 pieces	Ridging, 6 ft. long		...	0.40
12 hinges	4 in.		...	0.60
3 hinges	6 in.		...	0.20
10 kati	Nails, various		...	0.70
				$71.99
Total cost, including labour and transport (approximately)			...	$90.00

allowed between successive fires. The fire plan is not changed as the drying proceeds and is the same for each chamber as for the Type 7 kiln.

This twin kiln may be operated as a single unit, being loaded and emptied completely every 24 hours, or it may be worked in two halves, one half being used for freshly-split nuts while the other may be filled with semi-dried copra.

KILN TYPE 15.

Key to Diagram.

1. Main *atap* roof.
2. *Samai* matting walls.
3. Partition dividing copra.
4. Copra platform 7 feet above ground level.
5. Heat spreader 6 inches wide and 10 feet long.
6. Partition separating twin fire-pits.
7. *Atap* on wooden frame on sheet iron.
8. Hearth of loose brickwork, 4 bricks high.
9. Main ventilation, 2 inch screened slit.
10. Ventilation holes into hearth.
11. Space for 9 foot line of shells.
12. Space for 4 foot line of shells.
13. End wall of hearth, 2 bricks high.
14. Observation hole.
15. Pinang slats.

Thus 800 to 900 nuts can be brought in through the double doors on one side of the kiln every 12 hours after the equivalent of fully-dried copra has been ejected through a drop shutter on the far side of the kiln and the equivalent of semi-dried copra has been turned, so as to leave one half of the kiln empty.

Capital Cost.—If the kiln is kept in fairly regular daily use and operated throughout the night it can easily deal with 300,000 nuts per annum, equivalent to about 1,200 piculs of copra. The capital cost is about $90, which spread over three years, is equivalent to about 2½ cents per picul of copra, or 50 cents per acre.

It is anticipated that, in the kampong, the kiln could be erected by the owner himself, while cheaper materials could be used, so that it need cost only about $40. In this case, the capital cost of the kiln if used intermittently for a small acreage of coconuts is equivalent to about 8 cents per picul of copra or $2 per acre, which figures may be used as a guide in determining the apportionment of the cost when the kiln is operated on some form of share basis.

Acknowledgment.

The writer wishes to express his appreciation of the valuable assistance which Inche Abdul Rahman, Conductor of the Coconut Experiment Station, Port Swettenham, has rendered in building the various kilns and conducting the trials.

Summary.

Unscorched dry white copra can be obtained in 24 hours or less if the whole of the copra on a kiln is continuously heated and there are no cold spots. The kiln must be of a certain design to achieve this.

A number of very inexpensive kilns constructed of wood and *atap*, which will dry copra rapidly, and which have been built and operated successfully, are described.

APPENDIX I.

List of Small Kilns which may be inspected at the Coconut Experiment Station, Port Swettenham.

Type No.	Description	Platform Size and Area	Fire-Pit Height	Capacity (Nuts)
		EARLY KILNS.		
5A	Crude kampong kiln	10 ft. x 10 ft. = 100 sq. ft.	4 ft.	1,500
6A	Enclosed clay kiln	10 ft. x 10 ft. = 100 sq. ft.	6 ft.	1,200
7A	Experimental brick kiln	11 ft. x 10 ft. = 110 sq. ft	7 ft. 6 in.	1,500
		NEW TYPE KILNS.		
1	Cabinet (plank)	3 ft. x 3 ft. = 9 sq. ft.	6 ft. tunnel.	100
3	Single chamber (plank)	6 ft. x 3 ft. 6 in = 21 sq. ft.	6 ft.	300 to 350
4	Single chamber (*samai*)	8 ft. x 4 ft. = 32 sq. ft.	6 ft.	400 to 450
6	Twin (plank)	6 ft. x (4 ft. + 4 ft.) = 48 sq. ft.	6 ft.	600 to 650
7	Single chamber (*samai*)	10 ft. x 5 ft. = 50 sq. ft.	7 ft.	700 to 800
8	Twin (*samai*)	8 ft. x (4 ft. + 4 ft.) = 64 sq. ft.	6 ft.	800 to 1,000
15	Twin (plank)	10 ft. x (5 ft. + 5 ft.) = 100 sq. ft.	7 ft.	1,500 to 1,800

Warning.

With regard to the new type kilns, since the dimensions of the standard Type 3 have an experimental basis, any large departure from the specifications given above is not recommended. A considerable increase in either the length or breadth of the copra platform, for instance, will materially prolong the time of drying, since the copra outside the hot zone of the travelling cone of heat will remain cold for a longer time, while, away from the fires, cold air may actually pass down through the copra and so spoil the product. This occurs on the old Type "A" kilns which required two, three or even four days to dry copra properly, according to their size.

It may be noted that kiln Type 8 has 2 feet added to the length and 6 inches to the breadth of the grill of the standard Type 3 kiln, and the effect of these additions is to necessitate a longer period of drying with only one fire per chamber, 1,000 nuts taking 30 hours to dry.

With regard to the erection of demonstration kilns at selected centres, it is strongly recommended that the frequent opening and shutting of doors should be avoided by padlocking the doors. Any inspection of the fires can equally well be effected by means of spyholes suitably arranged, while the copra can be examined by cutting a plank in such a way that a small hinged flap may be opened and the hand inserted into the copra chamber. Water should be sprinkled over any glowing embers before a fresh supply of shells is arranged in the hearth.

APPENDIX II.

Brick Making.

The coastal clay which can be used for brick making in this country must be free from large quantities of organic (peaty) matter. It consists chiefly of hydrated aluminium silicate (the "true clay substance") with more or less sand, and oxide or carbonate of iron and only a small percentage of carbonate of lime. These clays usually burn to a salmon or red colour, and make strong bricks, the strength depending principally on the percentage of hydrated aluminium silicate present. Although the bricks are not required for building purposes and so need not be of great strength, it is necessary to carry out tests on the clays available in any particular district before proceeding with production on a larger scale.

The method of making bricks by hand is the same, with slight variation, all over the world. The top soil is removed until the clay is reached. Water is added to the clay which is well puddled and worked by the feet or poles until it is of a firm plastic consistency. The worked clay, which is made just sufficiently damp to adhere under pressure, is then pressed by hand into a four-sided wooden frame (without top or bottom) which is of the desired shape and size, allowance being made for the shrinkage of the brick in drying and firing. The internal dimensions of the moulds used in recent trials were 8 in. x 4 in. x 3 in.

The moulder stands at his bench, dips the mould in water (or water and then fine sand) to prevent the clay from sticking, takes up a piece of clay of adequate size and dashes it into the mould which is laid flat on the bench.

He then presses the clay into the corners of the mould with his fingers, scrapes off any surplus clay, levels the top by means of a strip of wood, and then turns out the shaped clay on to a board. This board may be provided with a flat, raised projection which will assist in loosening the clay from the sides of the frame.

The bricks can first be laid on the ground to dry in the sun. Subsequently, when sufficient have been prepared, they may be stacked in the form of a low wall one brick thick, in open formation, leaving spaces between each brick for the passage of air. Small *atap* roofs should be available in the event of rain as the bricks may be left for air-drying for as long as a fortnight.

The burning or firing of bricks is the most important factor in their production, since on this the strength and durability of the brick depends. The method of firing bricks in large permanent kilns, employed by the Chinese, is probably the best but the older method of firing in "clamps" is still employed in the smaller brickfields. These clamps are formed by arranging the unfired bricks in the form

of a rectangular stack leaving a space between each brick. Channels are formed in the bottom of the clamp and a fire-hole is arranged in each face of the stack and, in these, fires are kindled. Although clamp firing is slow and irregular, since not all the bricks are equally fired, it is employed wherever bricks are made on a small scale but, so that any cracked and faulty bricks may be discarded, it is recommended that more bricks should be moulded than are actually required. At the same time it is obvious that the firing of any underfired bricks can be completed during their use in the copra kiln.

Departmental.

FROM THE DISTRICTS.

Compiled by the Chief Field Officer from Monthly Reports by Agricultural Officers.

June, 1936.

The Weather.

Hot and dry weather prevailed throughout the country and the rainfall was below the average for the month at most of the stations from which records are received. Isolated exceptions were the coast around Malacca town and south Johore, Temerloh and Pekan in Pahang, and Kota Bahru in Kelantan, where precipitation was well up to or in excess of the average.

Remarks on Crops.

Padi.—Ploughing proceeded under favourable conditions throughout Kedah, except for Baling District, and some nurseries were established in the Kota Star and Kulim Districts. In Province Wellesley excessive water in some of the deeper areas of the north somewhat delayed the establishment of nurseries. In the newly alienated area at Sungei Acheh, felling and burning made good progress. In Perak, clearing and establishment of nurseries was in progress in the Bagan Serai mukim of Krian and in the north-west of this District. Preparation of the land is nearing completion in Bruas Sub-district and some sowing of nurseries has been done. Transplanting was general in the early areas of Batang Padang District. Irrigation water is available throughout Stage I of the Sungei Manik area and cultivation of the land commenced, whilst further considerable progress was made in the internal bunding of this area. In Stage II, felling is practically completed in the portion occupied by Banjarese, but slow progress was made in the part occupied by planters from Kuala Kangsar. In Selangor, transplanting is well forward in the northern padi areas of Ulu Langat and commenced in the southern part of the District. Felling and clearing continued at Panchang Bedena and further progress was made with bunding between the lots. In Negri Sembilan, transplanting was completed in Jelai mukim of Kuala Pilah District, is well advanced in Jelebu District, and was commenced in Tampin District. In Malacca, transplanting is nearing completion in the earlier areas of Alor Gajah District and ploughing progressed well in the remaining areas and in Central District. In Pahang, transplanting progressed in the down river mukims of Lipis District and throughout Bentong and Temerloh Districts. In Kelantan, ploughing of the dry padi areas is nearing completion and short term wet padi was sown in some localities. In Johore, planting is well advanced in the Endau and Segamat Districts.

Rubber.—There was little change in the price of small-holders' rubber during the month. The increased price for uncouponed rubber in the areas noted last

month was maintained, or showed a slight increase. Reports from Pahang indicate that dealers are generally maintaining the differences of price for various grades which provides for an adequate premium for the better prepared and smoked product, and reports from other parts indicate a general tendency to pay rather better prices than formerly for well-made smoked rubber. In the river mukims of Bruas Sub-district, Perak, eight cabinet smoke houses have been erected recently and reports state that others are in course of erection in various parts of the country.

Copra.—The price of copra appreciated during the month. Prices obtained by owners of approved kilns, whether of the Ceylon type or the newly designed cabinet type, show considerable differences in various parts as compared with the market quotations of Singapore and Penang. In some cases the difference is due to distance from these markets or poor local marketing facilities, but in other instances lower prices obtained are directly connected with lack of attention to detail on the part of the producer. An instance of a satisfactory price resulting from a well-placed position in regard to a ready market, coupled with attention to detail in manufacture, is provided in the report from Krian, Perak, which records that the owner of an approved brick kiln obtained the price of $5.18 a picul for a 70 picul lot of well-prepared copra on a day when the Penang quotation for first grade copra was $5.15 a picul. It is similarly reported that copra from a kiln in Pekan, Pahang, regularly obtains the Singapore price quoted at the time, whereas another kiln at Kuantan produces poorer copra owing to a mixture of unripe nuts amongst those used. In certain instances in Johore failure to obtain good prices is reported to be due to lack of grading of the product before sale. It is obvious that, apart from the provision of satisfactory kilns, much spade work will be needed to induce small-holders to exercise care both in nut selection and in grading the product for market, before small-holders' copra in general will command estate quality price. It is believed that the use of unripe nuts will be a particularly difficult fault to remedy, as the practice of gathering unripe as well as fully ripe nuts is a custom of long standing where nuts are reaped at bi-monthly intervals.

In the Bagan Datoh area all the approved kilns of brick or clay functioned during the month, whilst the erection of further cabinet kilns is reported from Selangor, where one 600 nut kiln was erected at Tanjong Karang, and from Johore, where two further 350 nut kilns were erected and a 1,500 nut kiln is nearing completion.

Agricultural Stations.—In Province Wellesley, on Bukit Mertajam Station, tea pruning was completed and the coffee topped, whilst cuttings of the Kinta variety of tuba were planted in the nursery. On Ayer Itam Station the tea plot was again supplied, half the pineapple plot was planted with Mauritius suckers, and a pig run was completed around one of the sties. At Kuala Kangsar Station in Perak, the tea was tipped and a beginning made with harvesting pepper. Trouble is being experienced from leaf-eating beetles on fruit trees both here and at the Province Wellesley Stations. At Tanah Rata Station, Cameron Highlands, holing

was completed for an extension to the China tea area and strawberry plants were planted. The yield of tea of 15,859 lbs. for the month shows the usual seasonal falling off in yield. A break of tea of 6,066 lbs. was despatched to London for sale. In Selangor, tapioca was planted following *Crotalaria* at Cheras Station, whilst the plant house at Telok Datoh Station was completed. In Negri Sembilan, some sixty marcots of rambutans and pulasans were basketed on the Seremban Fruit Nursery. At Kuala Pilah Station grease banding of coffee, done as a control measure against scale and mealy bugs, has resulted in the death of several plants. The grease, applied on the under side of paper cones tied round the main stems, melted and penetrated the tissues so deeply on several bushes as to kill a cylinder of bark and young wood tissue some 4 to 6 inches long. In consequence of this, all the stems and branches above the grease band died. At Sungei Udang Station in Malacca, the coffee was pruned, a plot of tuba planted, and a number of Pisang Embun added to the banana area, whilst nurseries were sown on the padi area of the Station. In Pahang, at Raub Station, coffee, manila hemp, groundnuts, gingelly and maize were planted. At Temerloh Station a number of annual crops were harvested. At Pekan Station *lalang* grass eradication by contract was completed. In Johore, *lalang* eradication was put in hand at the Pineapple Station, weeding of sporadic *lalang* amongst the cover crop done at the Central Station, whilst roads and drains were demarcated in the nursery area at Tangkak Station and the site for the Agricultural Assistant's quarters was pegged out.

Padi Experiment Stations and Test Plots.—Transplanting was in progress at Kajang Plot in Selangor; at Kendong and Ulu Klawang Plots in Negri Sembilan; at Pekan Station and Kerdau and Bawang Plots in Pahang, and at Tenglu and Jementah Plots in Johore. Nurseries have been sown on all the Kedah Stations and Plots except Pulai. Long-season padi was sown at Titi Serong Station and at the Test Plots in Krian, at Bruas Plot in Perak, Kuang Plot in Selangor, Ampang Tinggi Plot in Negri Sembilan, at Pulu Gadong Station in Malacca, at Lipis and Dong Plots in Pahang, and at Pasir Puteh Station in Kelantan.

Agricultural Show.

The Kedah Agricultural and Livestock Exhibition was held at Alor Star between June 12th and 14th. The Kelantan State Show was held at Peringat on 9th June whilst, in Johore, the Batu Pahat Show was held on the 25th and 26th. Numerous other District and Mukim Shows were held in connexion with the All-Malayan Padi and Rubber Competitions, as preliminaries to either a State Show or to the Thirteenth Malayan Exhibition. It is hoped that a brief description of these and other Shows fixed for the current month will be published in a later issue of this Journal.

DEPARTMENTAL NOTES.

Tours of the Adviser on Agriculture.

The Hon'ble the Acting Director of Agriculture, S.S., and Adviser on Agriculture, Malay States, toured the States of Negri Sembilan and Johore, and the Settlement of Malacca, between the 24th and 27th June. During his tour he inspected Agricultural Stations and Padi Test Plots, and attended the Agricultural Show held at Batu Pahat, Johore, on the 25th June.

Tour of the Rural Lecture Caravan.

The Rural Lecture Caravan toured the Settlement of Malacca from the 10th to 30th June, with a break for attendance at the Batu Pahat Agricultural Show on the 25th and 26th. It also attended the Kuala Kubu Show on 1st June.

Poultry Leaflets.

A new series of leaflets, similar to the Agricultural Leaflets already in circulation, is being prepared on poultry-breeding, and No. 1, The Feeding of Poultry, is now in the press. A supply of copies will be available for distribution at the forthcoming Thirteenth Malayan Exhibition to be held at Kuala Lumpur on the 1st, 2nd and 3rd August.

Leave.

Mr. H. D. Meads, Personal Assistant to the Adviser on Agriculture, has been granted 7 months and 12 days leave on full pay with effect from 20th June, 1936.

Mr. R. G. Heath, Agricultural Officer, Malacca, has been granted 7 months and 2 days leave on full pay with effect from 5th June, 1936.

Mr. G. D. P. Olds returned from leave on the 11th June, and assumed duty as Acting Personal Assistant to the Adviser on Agriculture.

Statistical.

MARKET PRICES.

June, 1936.

Major Crops.

Rubber.—The price of rubber again shewed an upwards tendency during June, the market rising steadily throughout the month. Spot loose opened in Singapore at 25⅜ cents per lb. and closed on a rising market at 26⅜ cents per lb. The average price for the month of No. 1. X. Rubber Smoked Sheet was 25.82 cents per lb. as compared with 25.63 cents in May. The London average price was 7.34 pence per lb., and the New York price 15.76 cents gold, as compared with 7.32 pence and 15.55 cents gold in the previous month.

Prices paid for small-holders' rubber at three centres during June are shewn in the following table.

Table I.

Weekly Prices Paid By Local Dealers for Small-Holders' Rubber, June, 1936.

(Dollars per Picul.)

Grades.	Kuala Pilah, Negri Sembilan.				Kuala Kangsar, Perak.				Batu Pahat, Johore.			
	4	11	18	25	3	10	17	24	3	10	17	24
Smoked sheet	32.00		32.75		31.63	32.00	32.40	32.70	31.75		31.81	33.00
Unsmoked sheet	31.00	31.31	31.00	32.00				31.50	30.90	31.00	31.10	
Scrap	28.00	28.00	26.00									

Transport by F. M. S. R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent

Palm Oil.—The market continued to fall, but improved at the close, and the following table gives the sterling prices during June for the Malayan commodities.

Table II.

Prices of Palm Oil and Palm Kernels.

Date 1936.	Palm Oil in Bulk, c i.f. landed weight Liverpool/ Halifax.	Palm Kernels, c.i.f. landed weight London/ Continent
	per ton	per ton
June 5	15. 10. 0	8. 15. 0
„ 12	15. 0. 0	9. 0. 0
„ 19	15. 0. 0	8. 17. 6
„ 26	16. 5. 0	9. 0. 0

Copra.—Prices improved steadily throughout June with a slight temporary falling off at the close. The sun-dried grade opened in Singapore at $4.85 per picul and rose to $5.30 on the 26th June, closing at $5.10. The average price for the month was $5.00 per picul as compared with $4.77 in May. The mixed quality averaged $4.74 per picul as compared with $4.50 in the previous month.

Copra cake improved to $1.50 per picul, the average for the month being $1.46 per picul as compared with $1.40 in May.

The following comparative London prices of copra are quoted as shewing the position held by Malayan copra in relation to the product of other countries. The prices are per ton, and are averages of the May quotations for the f.m.s. grade: Ceylon £17.0.0., Straits £13.2.0., Java £13.1.6., Philippines £12.9.6., South Seas £12.2.0.

Rice.—The average wholesale prices of rice per picul in Singapore in May were as follows:— Siam No. 2 (ordinary) $3.96, Rangoon No. 1 $3.55, Saigon $3.65, as compared with the April corresponding prices of $3.95, $3.45 and $3.67. May 1935 prices were $4.77, $3.77 and $4.05 respectively.

The average retail market prices in cents per gantang of No. 2 Siam rice in May were:— Singapore 28, Penang 28, Malacca 26, as compared with 28, 28 and 25 respectively in April.

The average declared trade value of imports of rice in May was $3.58 per picul, as compared with $3.66 in April, and $3.56 in March.

Padi.—The price of padi at the Government Rice Mill, Krian, was $1.90 per picul, but the volume of trade was negligible. Retail prices of padi ranged from 6 to 13 cents per gantang in different parts of the Peninsula.

Pineapples.—Singapore prices were raised slightly at the end of the month by the Packers' Combine, and average prices per case for June were: Cubes $3.12, Sliced Flat $3.01, Sliced Tall $3.12, as compared with $3.12, $3.03 and $3.10 respectively in May.

Prices of fresh fruit per 100 were:—Selangor $1.20 to $1.40; Johore 1st quality $1.85 to $2.60, 2nd quality $1.35 to $2, 3rd quality 60 cents to $2.

Beverages.

Tea.—Ten consignments of Malayan tea were sold on the London market during June, one being of upland tea which sold for 1s. 0½d. per lb. The consignments of lowland tea were sold at prices ranging from 11¼d. to 11¾d. per lb.

Average London prices per lb. during June for consignments of tea from other countries were as follows:— Ceylon 1s. 1.14d., Java 10.22d., Indian Northern 1s.0.21d., Indian Southern 1s.0.42d., Sumatra 10.02d.

The latest Colombo average prices available are quoted from the *Weekly Tea Market Report,* 22nd June, 1936, of the Colombo Brokers' Association, and are as follows (rupee cents per lb.):— High Grown Teas 69 cents, Medium Grown Teas 61 cents, Low Grown Teas 59 cents.

Coffee.—The price of Sourabaya coffee in Singapore during June fell sligtly, averaging $12.94 to $13.94 per picul according to quality. Palembang coffee averaged $7.37 to $8.37 per picul as compared with $7 to $7.94 in May.

Prices of locally grown coffee varied considerably according to districts, and ranged from $8 to $30 per picul.

Spices.

Arecanuts.—Prices in Singapore improved during June; averages per picul were Splits $4.81 to $6.69; Red Whole $5.44 to $6.56; Sliced $7.87 to $9.31.

The Singapore Chamber of Commerce prices rose considerably early in the month, and averages per picul were: Best $6.76, Medium $6.38, Mixed $5.18, as compared with $6.35, $5.90 and $4.49 respectively in May.

Pepper.—Nominal prices were further marked down in Singapore at the close of the month. The averages of the quotations per picul were: Singapore Black $8, Singapore White $15.75, Muntok White $16.25.

Nutmegs.—Prices in Singapore remained unchanged throughout the month at $28 and $29 per picul respectively for 110's and 80's, as compared with $27.50 and $28.50 in May.

Mace.—The Singapore market weakened and average prices per picul for June were:— Siouw $86.25, Amboina $71.25, as compared with $90 and $75 respectively in May.

Cloves.—Nominal quotations for Zanzibar and Amboina continued unchanged at $38 per picul.

Cardamoms.—Green cardamoms were quoted in the Ceylon Chamber of Commerce reports at Rs.1.50 to Rs. 1.60 rising to Rs. 1.60 to Rs. 1.75 at the close.

Miscellaneous.

Tuba Root (*Derris*).—Further falling off of demand, especially for rotenone-yielding roots, brounght about slightly lower prices, and the Singapore market was dull throughout the month. The average price per picul for June for roots sold on rotenone content was $50, and $34 for roots sold on a basis of ether extract. The May average prices were $51 and $34 respectively.

Gambier.—The Singapore market weakened still further at the close of June, and average prices per picul were Block $5.19, No. 1 Cube $10.38, as compared with $5.55 and $10.50 in the previous month.

Tapioca.—Singapore prices still continued unchanged at: Flake, Fair $5.40, Seed Pearl $5.50, Medium Pearl $6.50.

Sago.—Pearl, Small Fair, weakened slightly at the close to average $3.89 per picul, and Flour, Sarawak Fair, averaged $2.25 per picul, as compared with $3.90 and $2.26 respectively in May.

Tobacco.—In one District of Selangor prices of locally grown tobacco were high, being $100 per picul for 2nd quality, and $75 for 3rd quality. In Kelantan also, prices were high, the range being 1st quality $80, 2nd quality $70 to $85, 3rd quality $62.50 per picul. The range in other parts of the country was: 1st quality $20 to $31.50, 2nd quality $15 to $30, 3rd quality $10 to $16 per picul.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Guthrie & Co. Ltd., Kuala Lumpur; the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore, and tuba prices by Messrs. Kohyei & Co., Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross. London, S.W.1.

GENERAL RICE SUMMARY*

May, 1936.

Malaya.—Imports of foreign rice during May were 58,161 tons, and exports 12,874 tons. Net imports for the first five months of the year totalled 211,314 tons, as compared with 186,374 tons in 1935, an increase of 13.4 per cent.†

Of the imports during May, 47 per cent. were consigned to Singapore, 17 per cent. to Penang, 9 per cent. to Malacca, 21 per cent. to the Federated Malay States and 6 per cent. to the Unfederated Malay States. Of the total, 65.4 per cent. came from Siam, 28.8 per cent. from Burma, 4.8 per cent. from Indo-China, and 1 per cent. from other countries.

Of the May exports, 74 per cent. were consigned to the Netherlands Indies, and 26 per cent. to other countries. The various kinds of rice exported were as follows (in tons, percentages in brackets):—Siam 9,513 (73.9), Burma 2,541 (19.7), French Indo-China 580 (4.5), parboiled 176 (1.4), local production 64 (0.5).

India and Burma.—Foreign exports during January to April totalled 553,000 tons, as compared with 774,000 tons in 1935, a decrease of 28.6 per cent. Of these exports 4.3 per cent. were to the United Kingdom, 21.2 per cent. to the Continent of Europe, 25.7 per cent. to Ceylon, 19.0 per cent. to the Straits Settlements and the Far East, and 29.8 per cent. to other countries. The corresponding 1935 percentages were 4.8, 10.5, 19.8, 34.7 and 30.2.

Siam.—Exports of rice and rice products from Bangkok during April are provisionally given as 152,019 tons, the cumulative total for the year being 546,583 tons as compared with 588,632 tons in 1935.

Japan.—Estimated demand and supply for the six months May to October inclusive are as follows:—

			tons
Supply:	Stocks on 1 May 1936	...	4,892,992
	Imports of Korean rice	...	462,833
	Imports of Formosan rice	...	434,783
	Total	...	5,790,608
Demand:	Consumption	...	4,516,134
	Exports	...	37,868
			4,554,002

* Abridged from the Rice Summary for May, 1936, compiled by the Department of Statistics, Straits Settlements and Federated Malay States.

† It is to be understood throughout the summary that all comparisons and percentage increases or decreases are in relation to the corresponding period of 1935.

Stocks:	Between-season 31st October 1936 Government-owned rice	...	897,616
	Privately-owned rice	...	338,990
			1,236,606

French Indo-China.—Entries of padi into Cholon during the first five months of 1936 totalled 778,824 metric tons, a decrease of 21 per cent. as compared with 985,554 metric tons in 1935. Exports for the same period decreased by 22.5 per cent. from 1,031,961 metric tons in 1935 to 799,417 metric tons in 1935.

Netherlands Indies.—The latest information available was published in the February Summary.

Ceylon.—Imports during January to May totalled 224,456 tons, as compared with 220,373 tons in 1935, an increase of 1.9 per cent. Of these imports 12.6 per cent. were from British India, 62.9 per cent. from Burma, 0.2 per cent. from the Straits Settlements, and 24.3 per cent. from other countries. The corresponding 1935 percentages were 11.5, 70.5, 1.4 and 16.6.

Europe and America.—Shipments from the East to Europe during the period 1st January to 7th May totalled 431,537 tons as compared with 361,532 tons in 1935, an increase of 19.4 per cent. Of these shipments, 44.4 per cent. were from Burma, nil from Japan, 45 per cent. from Saigon, 8.7 per cent. from Siam, and 1.9 per cent. from Bengal. The corresponding 1935 percentages were 67.5, 2.1, 23.2, 4.5 and 2.7.

Shipments for the Levant from the 1st January to 6th May were 6,327 tons, a decrease of 67.4 per cent. when compared with the 1935 shipments of 19,428 tons. Shipments for Cuba, West Indies and America from the 1st January to 8th May totalled 83,425 tons as compared with 99,277 tons in 1935, a decrease of 16 per cent.

MALAYAN AGRICULTURAL EXPORTS, MAY, 1936.

PRODUCT.	Net Exports in Tons				
	Year 1935	Jan.-May 1935	Jan.-May 1936	May 1935	May 1936
Arecanuts ...	21,588	10,110	12,228	1,860	1,577
Coconuts fresh † ...	106,272†	39,093†	44,614†	7,169†	6,842†
Coconut oil ...	35,911	12,504	18,547	2,705	4,163
Copra ...	111,752	42,814	26,548	3,734	5,107
Gambier, all kinds ...	2,837	1,139	897	208	135
Oil cakes ...	11,361	3,246	5,326	555	1,298
Palm kernels ...	3,892	1,381	1,662	310	369
Palm oil ...	24,598	8,677	8,664	1,585	1,059
Pineapples canned ...	73,923	29,284	32,168	8,795	9,891
Rubber ¶ ...	378,381¶	164,398¶	138,637¶	32,930¶	26,331¶
Sago,—flour ...	10,920	4,778	3,082	183	1,632
,, —pearl ...	4,655	1,837	1,368	351	367
,, —raw ...	7,735*	2,766*	3,590*	639*	845*
Tapioca,—flake ...	1,953	848	820	266	133
,, —flour ...	755*	461*	833*	156*	203*
,, —pearl ...	17,169	6,553	6,084	1,703	1,082
Tuba root ...	567	256½	308	79½	62

† hundreds in number. * net imports. ¶ production.

MALAYAN PRODUCTION (IN TONS) OF PALM OIL AND KERNELS

(As declared by Estates)

Month 1936	Palm Oil		Palm Kernels	
	F.M.S.	U.M.S.	F.M.S.	U.M.S
January ...	1,395.4	326.5	258.6	37.2
February ...	1,531.9	372.4	244.2	54.6
March ...	1,878.4	534.5	302.9	88.0
April ...	1,410.6	446.8	250.0	80.0
May ...	1,346.1	644.8	238.1	114.6
Total ...	7,562.4	2,325.0	1,293.8	374.4
Total January to May 1935 ...	5,229.3	1,684.2	818.1	240.2
Total for year 1935 ...	17,338.7	5,764.6	2,711.1	818.4

MALAYAN RUBBER STATISTICS

ACREAGES OF TAPPABLE RUBBER NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 31ST MAY, 1936.

STATE OR TERRITORY	Acreage of Tappable Rubber end 1935	ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		ESTATES WHICH HAVE PARTLY CEASED TAPPING (*a*)		AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED		Total (3) + (5)	Percentage of (9) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STRAITS SETTLEMENTS :—									
Province Wellesley	44,526	562	1.3	16,922	38.0	672	1.5	17,484	39.3
Malacca	121,601	4,931	4.1	33,821	27.8	2,928	2.4	38,752	31.9
Penang Island	2,575	Nil	Nil	569	22.1	283	11.0	569	22.1
Singapore Island	34,525	4,537	13.1	9,235	26.8	394	1.0	13,772	39.9
Total S.S. ...	203,227	10,030	4.9	60,547	29.8	4,277	2.1	70,577	34.7
FEDERATED MALAY STATES :—									
Perak	294,988	12,412	4.2	73,655	25.0	14,497	4.9	86,067	29.2
Selangor	332,165	12,222	3.7	74,357	22.4	16,827	5.1	86,579	26.1
Negri Sembilan	258,304	16,996	6.6	54,900	21.2	16,992	6.6	71,896	27.8
Pahang	77,210	10,822	14.0	28,085	36.4	18,215	23.6	38,907	50.4
Total F.M.S. ...	962,667	52,452	5.4	230,997	24.0	66,531	6.9	283,449	29.4
UNFEDERATED MALAY STATES :—									
Johore	432,443	35,455	8.2	68,365	15.8	39,792	9.2	103,820	24.0
Kedah	199,607	3,880	2.0	22,423	11.2	19,349	9.7	26,303	13.2
Kelantan	30,474	403	1.3	10,470	34.4	5,330	17.5	10,873	35.7
Trengganu (*b*)	4,643	Nil	Nil	15	0.3	179	3.9	15	0.3
Perlis (*c*)	1,575	Nil	Nil	653	41.5	59	3.7	653	41.5
Brunei	6,010	Nil	Nil	1,683	28.0	893	14.9	1,683	28.0
Total U.M.S. ...	674,752	39,738	5.9	103,609	15.3	65,602	9.7	143,347	21.2
TOTAL MALAYA ...	1,840,646	102,220	5.5	395,153	21.5	136,410	7.4	497,373	27.0

Notes :—(*a*) Area out of tapping on Estates which have partly ceased tapping refers to areas definitely being rested and excludes areas on any tapping round.
(*b*) Registered Companies only.
(*c*) Rendered quarterly.

MALAYAN RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF MAY, 1936, IN DRY TONS.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports during the month		Imports January to May 1936		Exports including re-exports during the month		Exports including re-exports January to May 1936		Stocks at end of month			Consumption 3	
	Ports	Dealers	Estates of 100 acres and over	during the month	January to May 1936	during the month	January to May 1936	Foreign	From Malay States & Labuan	Foreign	From Malay States & Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over	during the month	January to May 1936
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MALAY STATES :—																				
Federated Malay States ...	...	7,983	10,834	9,441	47,292	4,199	28,786	Nil	Nil	Nil	Nil	12,015	2,270	55,080	16,322	...	7,091	11,072	9	37
Johore ...	...	2,565	4,024	3,863	19,528	2,282	14,279	Nil	108	Nil	299	2,814	3,749	10,749	22,932	...	2,295	3,984	...	...
Kedah ...	...	337	2,652	2,421	12,370	635	3,108	Nil	Nil	Nil	Nil	1,795	1,378	6,901	9,270	...	351	2,521	...	...
Perlis ...	...	14	19	10	55	11	93	Nil	Nil	Nil	Nil	Nil	30	Nil	148	...	7	17	...	...
Kelantan ...	...	259	232	268	1,344	476	2,564	Nil	Nil	Nil	Nil	126	592	749	3,193	...	254	263	...	...
Trengganu ...	...	55	50	236	1,069	118	535	Nil	Nil	Nil	Nil	Nil	354	Nil	1,604	...	55	50	...	...
Brunei ...	...	8	24	38	199	47	285	...	...	...	...	...	67	...	487	...	13	37	...	...
Total Malay States	...	11,221	17,835	16,277	81,857	7,768	44,650	Nil	108	Nil	299	16,750	8,440	73,479	53,956	...	10,066	17,944	9	37
S. SETTLEMENTS :—																				
Malacca ...	...	2,069	1,187	945	4,875	478	2,645	Nil		Nil		2,505		11,088		...	2,319	1,167	...	...
Province Wellesley ...	...	1,036	527	401	1,923	167	988	Nil		Nil		5,830		35,284		...	947	532	...	...
Penang ...	1,035	5,299	8	18	82	50	334	2,044	10,006	12,191	53,730		Nil		Nil	1,357	4,805	11	...	...
Singapore ...	4,127	21,739	191	141	719	72	490	10,413		58,119		21,483		87,057		3,083	17,442	176	23	107
Labuan ...	...	16	Nil	Nil	Nil	14	74	70		384		Nil		Nil		...	17	Nil	...	...
Total Straits Settlements ...	5,162	30,159	1,913	1,505	7,599	781	4,531	12,527	10,006	70,694	53,730	29,818	Nil	133,429	Nil	4,440	25,530	1,886	23	107
Total Malaya ...	5,162	41,380	19,748	17,782	89,456	8,549	49,181	12,527	10,114	70,694	54,029	46,568	8,440	206,908	53,956	4,440	35,596	19,830	32	144

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	6,106	16,792	4,521	2,834	2,001	169
WET RUBBER	985	650	284	462	294	182
TOTAL ...	7,091	17,442	4,805	3,296	2,295	351

TABLE III
FOREIGN EXPORTS

PORTS	For month	January to May 1936
29	30	31
Singapore ...	31,507	131,259
Penang ...	9,677	51,104
Port Swettenham.	5,116	23,327
Malacca ...	268	1,218
MALAYA ...	46,568	206,908

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	January to May 1936
32	33	34
Malay States ...	25,190	127,435
Straits Settlements	1,909	11,230
MALAYA ...	27,099	138,665

Notes :—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.
2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Column (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication, therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 24th June, 1936.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1936.

Locality.	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine.		
	Means of			Absolute Extremes						Total.		Most in a day.	Number of days.					Total.	Daily Mean.	Per cent.
	A. Max.	B. Min.	Mean of A and B.	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						Hrs.	Hrs.	
Railway Hill, Kuala Lumpur, Selangor ...	91.2	73.3	82.3	95	69	86	78	84.7	85.5	14.49	368.1	2.27	19	17	7	4		177.55	5.73	47
Bukit Jeram, Selangor ...	88.4	73.6	81.0	91	71	81	77	84.4	86.7	11.27	286.3	3.95	15	13	2	2	3	213.20	6.88	56
Sitiawan, Perak ...	89.1	74.3	81.7	92	70	81	77	84.8	85.2	5.97	151.7	1.30	14	12	1			198.10	6.39	52
Temerloh, Pahang ...	89.8	73.7	81.7	93	68	86	77	86.3	86.5	11.29	286.8	2.32	19	19	2	5		180.00	5.81	47
Kuala Lipis, Pahang ...	89.6	72.6	81.1	92	68	85	76	85.0	85.3	10.75	273.1	2.50	19	17	2	14	1	168.75	5.44	44
Kuala Pahang, Pahang ...	87.2	75.0	81.1	90	73	82	77	86.0	86.6	5.65	143.5	1.28	17	14				201.75	6.51	53
Kallang Aerodrome, S'pore ...	86.8	77.2	82.0	90	74	82	82	83.1	84.1	10.34	262.6	2.08	17	13	5			182.30	5.88	48
Butterworth, Province Wellesley ...	88.5	75.3	81.9	92	73	81	79	86.4	86.8	11.73	297.9	3.91	20	16				209.65	6.76	55
Bayan Lepas Aerodrome Penang ...	87.9	75.3	81.6	91	73	82	78	85.1	85.6	9.64	244.9	2.17	19	17	2			197.35	6.37	52
Bukit China, Malacca ...	85.7	74.9	80.3	89	72	82	77	84.4	85.3	8.79	223.3	2.58	22	17	3		2	193.65	6.25	51
Kluang, Johore ...	88.5	72.6	80.5	92	70	76	76	83.1	83.1	10.79	274.1	2.20	18	17	3	12		172.20	5.55	45
Bukit Lalang, Mersing, Johore	86.5	73.1	79.8	92	71	78	75	82.7	82.1	8.48	215.4	2.07	13	12	3	1		201.40	6.50	53
Alor Star, Kedah ...	88.7	75.8	82.3	93	73	80	78	87.3	87.0	9.93	252.2	3.33	19	15	1	2		200.60	6.47	52
Kota Bahru, Kelantan ...	89.8	74.9	82.3	94	72	86	78	85.1	85.1	7.74	196.6	2.61	11	10	3		1	219.10	7.07	57
Kuala Trengganu, Trengganu	88.5	74.4	81.5	91	72	83	77	84.2	85.0	8.83	224.3	3.98	14	11	2			216.65	6.99	57
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	75.7	63.6	69.7	79	60	71	66	73.2	73.2	11.62	295.2	2.05	22	21	1	13		154.10	4.97	40
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	74.1	57.8	65.9	78	48	67	63	71.0	70.8	11.93	303.0	2.42	21	18	1	4	2	144.30	4.65	38
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	72.3	60.7	66.5	77	58	66	63			12.67	321.8	2.49	21	18	1	4	2	151.00	4.87	39

Compiled from Returns supplied by the Meteorological Branch, Malaya